THE

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DEPRECIATION: FACT v. FICTION.

IN our "Lighting and Power Notes" this week we publish certain interesting items from the last annual report of Mr. Forbes Mackay, the city electrical engineer of Sydney, N.S.W.

Not the least noteworthy portions of this report are the concluding paragraphs, which give us a prominent Australian municipal engineer's views of the practice obtaining among British municipal undertakings in regard to depreciation. As will be seen from the following quotations, these views are quite at variance with the actual facts, and we are somewhat surprised that an engineer of Mr. Mackay's standing should not be better informed. He says:—

> Some British cities have had their electric supply undertakings in operation for many years, and the provision made for depreciation by these cities gives an indication of what they have found it necessary to set aside for this purpose. Depreciation is not provided for in British municipalities by establishing a fund or opening an account called "Depreciation Fund" or "Account." Loans are raised with the times of repayment so fixed that the amounts provided for sinking fund make allowances for depreciation unnecessary.

He then cites the average percentage (2·73) of the annual sinking-fund charges to capital expenditure in the case of 10 well-known British municipal undertakings of 15 to 25 years' existence, as a measure of the depreciation allowance in those cases, comparable with the 4 per cent. (3 per cent. depreciation and 1 per cent. sinking fund) allowance at Sydney in 1909. Among the undertakings which Mr. Mackay, no doubt quite unintentionally, libels, are Glasgow, Manchester, Liverpool, Leeds, Bristol, Sheffield, Birmingham, &c. We do not suppose that any experienced municipal engineer in this country, working under the usual loan conditions, will be found seriously to argue that his sinking-fund repayment sufficiently provides for renewing his plant at the expiration of its period of useful or probable life. In quite recent years, a paternal Government has certainly exerted its influence to cut down loan periods, so that some sort of relation should exist between loan period and estimated life of plant; but this does not apply in the case of "undertakings in operation for many years," nor in the case of the 10 undertakings mentioned by Mr. Mackay, the engineers of which, we imagine, would be the first to assure him of the inadequacy of their loan repayments for depreciation purposes.

The subject is a particularly familiar one in our pages, and, through them, to municipal engineers in this country, and if evidence confirmatory of our remarks were required, Mr. Mackay need only study the accounts of the undertakings which he named in his report, to find that very substantial reserve and renewals funds for depreciation are being accumulated—in fact, in some instances have been used—to supplement the deficiencies of sinking-fund repayments, when the useful life of plant has, as is frequently the case, proved much shorter

than was estimated. To refer to one or two specific instances:—Since 1894, Manchester has contributed £616,248 towards its sinking fund, and £232,897 towards renewals, the latter fund being drawn on only last year to the extent of over £20,000 for plant discarded, &c. A reserve fund of over £20,000 is also in existence.

The Birmingham accounts show some £34,000 paid towards loan redemption last year; also £9,000 placed in the renewals fund, but £14,461 was also spent out of revenue in reconstructing and writing down abandoned plant (£17,000 being devoted to the same purpose in the previous year), and it must not be forgotten that a reserve fund of over £70,000 exists, although during the last year no contribution was made to it from revenue. The Bristol accounts for past years show, even more than in the above cases, the insufficiency of loan redemption for depreciation purposes, and we could go on multiplying instances of the same kind.

Really, Mr. Mackay, really—and this after all our efforts in the past to promote sound municipal finance, efforts which, we believe, have not been without result.

Copper.

It is always a little difficult to understand why it is customary to call the general position of a commodity "bad" when the price is moderate. In cases where the quality is standard, and sufficiently well supervised to ensure that it remains so, for the price to be low is surely beneficial to the community. In many branches of commerce we are constantly accused of setting cheapness first, and quality nowhere. There is always a natural mean, below which production will be curtailed, and above which manufacture will be crippled, in the price of all raw material. Copper at £54 per ton is certainly not below it. The view that the price is low, however, seems to be taken by the writer of an able article in the *Times* of July 22nd. The demand, we are told, has been good, but prices have fallen off owing to the accumulated stock. The rumours of consolidation (which has been, so far, confined to the Montana mining companies) have induced holders to retain their interests, and thus accumulate stock which must ultimately come on the market. American stocks have also risen, and, at the end of June, the aggregate European and American stocks amounted to 179,000 tons, representing a net increase, for the half-year, of 7,000 tons. This would represent three months' consumption, without making allowance for the invisible stocks held by consumers. Figures are given of European and American stocks to June 30th. European, as we know, have declined from the highest return, 113,455 tons, at the end of February, to 103,957 tons at the end of June. American stocks were lowest in January at 43,957 tons, and since then have increased at a rate varying from 6,000 to 8,000 tons per month, to 75,172 tons for the end of June. Consumption, we are told, has been stimulated by low prices, but this does not entirely account for the strong consumers' withdrawals in the States, which amounted to 30,000 tons more for the half-year than for the corresponding six months of last year. American production, despite the much-talked-of "limitation" and arrangements, has increased during the last three months, though the rate of increase must be somewhat discounted by the fact that the figures include product of imported raw material. The production figures for April, May and June are 52,445 tons, 55,019 tons and 56,793 tons respectively. The imports of fine copper into England and France from January 1st to June 30th, in 1910, were as follows:—From Chile and Bolivia 13,959 tons, from United States 38,590 tons, from other sources 53,768 tons. This last figure is considerably in excess of that for the three preceding years, and looks as if other sources than the States were being rapidly developed. The article concludes with the deduction that, on the present output rate, the United States will produce 680,000 tons during the year, which will be a surplus over consumption of 80,000 to 100,000 tons.

The figures are taken from those issued by the American Producers' Association.

Electricity in Agriculture.

The increasing interest manifested by agriculturists in the use of electricity in Germany is illustrated by the resolutions which were adopted at the 26th conference of the Agricultural Co-operative Association, recently held at Coblence. The conference expressed the opinion that the supply of the flat country with electrical energy is an economic measure in which all professional circles have the same vital interest. It is, therefore, in the interests of the State to further the extension of electrical energy by the means at its disposal in the form of the grant of cheap credit and authoritative support. A practical activity of the State in the production and distribution of electricity is recommended above all where the State has possession of sources of power or where it must produce electricity for State establishments. The conference also resolved that a special duty devolved upon Unions of communal authorities in regard to the advancement of the supply of electricity in their districts by:—

1. The granting of free use of the roads for cables, and otherwise supporting the undertaking.
2. The arrangement of long-term contracts between suppliers and consumers.
3. The placing of the communal credit at the disposal of the electrical undertaking.
4. Financial participation in the undertaking.
5. The introduction of the supply of electricity on communal account.

It was further resolved that where an undertaking was taken in hand it was urgent that the Councils of the Agricultural and Co-operative Unions should be consulted on the matter.

The Right to Operate a Telegraph.

Owing to the peculiarities of the British law with regard to telegraphs and telephones, questions relating to the construction of contracts between telegraph companies and other persons do not often arise in this country. It is otherwise in Canada, where cases involving disputes with telegraph companies are of frequent occurrence. In a case heard in the Privy Council last week (The Reid Newfoundland Co. *v.* The Anglo-American Telegraph Co.), a curious question arose. It appeared that the plaintiff company, which owned a railway, in 1888 granted to the telegraph company the exclusive right, at all reasonable times, to enter upon the land of the company and thereon lay down special wires for the use of the company. It was a term of the agreement, however, that one line should be laid for the use of the railway company in connection with the working of the line. Finding this line to be insufficient to meet their ever-increasing needs, the railway company put in another line on their own account. The telegraph company sought to prevent their doing this, on the ground that it was an infringement of the agreement, which, they alleged, conferred a monopoly. The Courts in the Colony adopted this view, but the Privy Council have come to the conclusion that the exclusive privilege of erecting and working telegraph lines for the business of the telegraph company did not exclude the right of the railway company to erect and work telegraph lines on its own property for the purposes of its railway business. This being so, the railway company obtained judgment. The decision appears to accord with justice and good sense; for if the railway company had surrendered all its powers to the telegraph company, the working of the line might have been very seriously impeded.

SOME NOTES ON THE USE OF INSTRUMENT TRANSFORMERS.

BY KENELM EDGCUMBE.

A LARGE number of investigations have been undertaken from time to time in connection with current and pressure instrument transformers; but the investigators have usually contented themselves with laying down the best lines along which to proceed in the design of such transformers, while any quantitative results have usually been confined to a few isolated figures, with little or no reference to the particular purpose for which the transformer was intended. Such being the case, the following notes may possibly be of assistance in showing to what extent such transformers can be employed with confidence, and where, on the other hand, caution is necessary as regards their use.

Since an instrument and its transformer are used together, their performance must be considered as a whole, the combination forming, in fact, a single "measuring instrument." The errors introduced by current and pressure transformers are two in number :—

1. An error in ratio.
2. A phase displacement between the primary and secondary currents or pressures as the case may be.

An ammeter can usually be calibrated in conjunction with its own current transformer, in which case no error is introduced. Occasionally, however, this is not possible, as, for example, where a single ammeter is to be used to indicate the current flowing in any one of a number of circuits, each having its own current transformer. Even in such a case, however, it is usually possible so to scale the ammeter that the average ratio curve of the transformers is taken into account. The same remarks are applicable to voltmeters.

The case of a wattmeter is not so simple. Any attempt at adjustment to suit the ratio curve of a transformer is frustrated by variations of power factor and voltage, since the deflection on the instrument bears no fixed relation to the current flowing. Moreover, any phase displacement between the primary and secondary currents or pressures may produce a serious error, particularly at low power factors. It is sometimes possible, in the case of switchboard instruments where both pressure and power factor are fairly constant, so to calibrate a wattmeter in connection with its transformers as to eliminate ratio and phase errors, but this can only be done to a very limited extent.

A watt-hour meter suffers from precisely the same troubles as a wattmeter in this respect, with the added disadvantage that any errors are cumulative.

In a power-factor meter, lack of constancy in ratio is entirely without effect, and the error due to phase displacement is merely equal to the phase difference which exists between the primary and secondary currents or pressures, and is, for all practical purposes, negligible.

Overload and minimum relays fall into the same category as ammeters and voltmeters, but the accuracy called for is usually so small that transformer errors can be entirely neglected in most instances.

Reverse relays are really nothing more than wattmeters, and the same remarks apply, except that, being relays, the small errors introduced by the transformers are comparatively unimportant, since the accuracy called for is seldom great.

Before considering the actual magnitude of the errors likely to be introduced by the use of instrument transformers, it may be well to draw attention to a very common source of inaccuracy, depending on the range chosen for the instrument itself, and one which is considerably aggravated by the use of transformers. This lies in the attempt, so often made, to use an instrument at the very lowest part of its scale. If it is merely intended roughly to gauge the current flowing, an ammeter may be used down to a tenth, or, if the scale be evenly divided, to a twentieth of its full scale, but if accuracy is desired, it should never be used below a fifth of its range. The scale of a multi-range instrument must, accordingly, be chosen with this end in view, and in the case of an ammeter or voltmeter, each range should not be less than one-tenth or one-fifth of the next higher, according to whether the scale is evenly divided or not.

This question of range is of particular importance in the case of wattmeters, since it is then not merely a question of current, but also of pressure and power factor. In a switchboard instrument the pressure may often be regarded as constant, for all practical purposes, so that it is then only the current and power factor which have to be considered. As showing the importance of this matter, the case may be taken of a wattmeter designed for a maximum of 100 amperes at 500 volts single-phase, that is, for a full load of 50 KW. at a power factor of unity. At 40 amperes, and a power factor of 0·6, the reading is 12 KW., that is to say, the pointer indicates less than one-fourth of the full scale, although the current itself is nearly half that corresponding to full load.

In the case of a portable wattmeter, intended for general testing work, the difficulties are still greater, the voltages met with being probably considerably below the maximum for which the instrument is rated. For example, in the above case the nearest range on a portable wattmeter would very likely be 100 amperes and 750 volts, the instrument probably being scaled to $750 \times 100 = 75$ KW., so that the 12 KW. to be measured is less than one-sixth of the full scale reading, and consequently cannot be read with any degree of exactness. Even if the instrument is provided with more than one current range, this is of little assistance, since the current (40 amperes) will almost certainly be considerably in excess of that which the next lower range (probably designed for a maximum of 10 or 20 amperes) will safely carry.

For this reason the practice followed by the majority of makers, in scaling wattmeters to the number of watts corresponding to the product of maximum amperes into maximum volts, is very much to be deprecated, and, in the writer's opinion, the full scale should never be more than 70 per cent. of the volt-amperes so computed.

When using current transformers the importance of choosing a suitable range is still further emphasised by the fact that the ratio can only be regarded as constant down to one-fifth, or, in special cases, one-tenth of its carrying capacity.

Fig. 1 shows the ratio curve of a well-known type of current transformer having a nominal ratio of 125 : 5, and designed for 6,000 volts, and a secondary P.D. of about 2 volts at

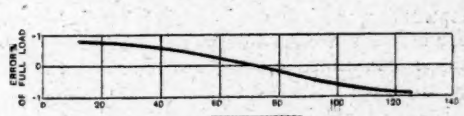


FIG. 1.—RATIO CURVE OF CURRENT TRANSFORMER.

5 amperes—that is to say, corresponding to 10 volt-amperes at full load. The error is plotted as a percentage of the full-load current, which is undoubtedly the most rational method, since it is the one universally adopted in the case of the measuring instruments themselves with which the transformers are to be used. It will be noticed that the error in ratio is less than 1 per cent. at all points down to one-tenth of its carrying capacity. Moreover, the secondary load of 10 volt-amperes is considerably higher than is usually demanded of a current transformer, so that it may safely be said that the variation of ratio in a well-designed transformer need introduce no error of any importance in practical working. That some care is very necessary as regards design may, however, be gathered from fig. 2, which shows the ratio curve of another well-known make of current transformer (90 : 5 amperes), from which it will be seen that the error, even at one-fifth load, amounts to over 2 per cent., and at one-tenth load to more than 3·5 per cent. of the full-load current.

Turning, now, to the vexed question of the phase errors in transformers: if the primary and secondary currents are displaced by an angle α, with regard to one another, a wattmeter connected to the secondary of such a transformer will measure $V \times A \times \cos(\phi - \alpha)$ instead of $V \times A \times \cos\phi$, where ϕ is the phase displacement of the load. Fig. 3 shows the phase displacement between the primary and secondary currents of a current transformer similar to that of which the ratio curve is given in fig. 1. The curve shows that the phase displacement at quarter load is 0·4°, and at one-eighth load 1·0°.

In the following table are given the errors which would result at various power factors in a wattmeter when worked off such a transformer:—

PERCENTAGE ERRORS INTRODUCED IN A WATTMETER BY THE USE OF A CURRENT TRANSFORMER.*

Volts.	Amperes.	Power factor.	True power in kilowatts.	Phase error in degrees.	Error in reading as a percentage of the full scale.
500	100	1·0	50	+ 0·6°	0
,,	125	0·8	,,	+ 0·4°	0·17
,,	166	0·6	,,	+ 0·2°	0·2
,,	250	0·4	,,	− ·06°	0·1
,,	500	0·2	,,	− ·05°	0·17
,,	1,000	0·1	,,	− ·07°	0·4

* The phase errors are taken from the transformer, the curve of which is shown in fig. 3. It is designed for a primary full load current of 500 amperes, and the wattmeter was scaled to 150 KW.

The error is extremely small throughout, increasing as the power factor decreases; the percentage error is, in fact, 100 a tan ϕ, where cos ϕ is the power factor and a, as before, the phase error in degrees. The table is worked out on the assumption that the wattmeter is scaled to 150 KW. at 500 volts, and that the current transformer is designed to carry

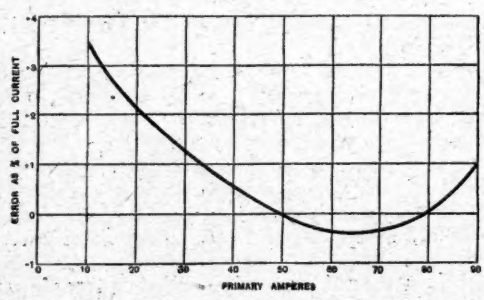


FIG. 2.—RATIO CURVE OF CURRENT TRANSFORMER.

500 amperes as a maximum. It is, therefore, being used at one-third of the full scale deflection throughout—that is to say, the *power* measured remains constant, and the current consequently increases as the power factor decreases. At power factors below 0·2 the current transformer will be overloaded and could only be used for temporary measurements.

The wattmeter in question gives a full deflection, as has been said, with 150 KW., that is, with 60 per cent. of its full volt-ampere capacity. It is much more likely, however, that the wattmeter used would be such that, at the low power factors, it gave only one-tenth or even one-twentieth of its

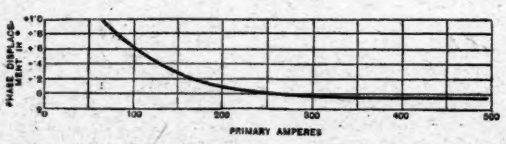


FIG. 3.—PHASE DISPLACEMENT IN CURRENT TRANSFORMER.

full deflection, and consequently the accuracy would depend much more on errors inherent to the wattmeter itself than on any phase displacement in the transformer.

The lower the power factor the higher will necessarily be the primary current, if a readable deflection is to be obtained, and, as shown in fig. 3, the phase displacement decreases rapidly as the primary current increases. The result of this is clearly seen in the table, where it will be noticed that at low loads, although the phase displacement is 0·6° (and even such a displacement involves extremely careful design) the corresponding power factor is fairly high, and the percentage error consequently quite negligible. At low power factors, on the other hand, where the effect of even a small phase displacement becomes of considerable importance, the current transformer is working more nearly at full load, and the phase displacement becomes small. Thus the resulting error throughout the entire range at no point exceeds 0·5 per cent. of the full scale deflection.

So far only current transformers have been considered. The errors introduced by the use of pressure transformers are similar, but much smaller in magnitude; in fact, for all industrial purposes the ratio and phase errors introduced by well designed pressure transformers can be entirely neglected.

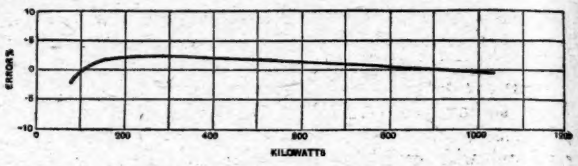


FIG. 4.—ERROR CURVE OF WATT-HOUR METER ALONE.

It may be noticed in passing that when using both current and pressure transformers in connection with an instrument, the phase error of one tends to cancel out that of the other, any displacement due to the potential transformer being neutralised to a corresponding extent by a displacement due to the current transformer, and *vice versâ*, so that the resulting phase error is only the *difference* between these two displacements.

Another direction in which a partial compensation may occur is in connection with a watt-hour meter, the natural curve of the meter being sometimes improved by the ratio curve of the current transformer. Figs. 4 and 5 illustrate this possibility. Fig. 4 gives the error curve of a three-phase balanced load watt-hour meter when used direct, and fig. 5 the corresponding curve when the meter was tested in conjunction with a current transformer. It will be seen that the combined curve shows a reduced error at most points, and particularly between half and one-fifth load, which usually forms so important a part of the range. At the lowest points, on the other hand, the errors are considerably increased.

There is another question of considerable importance, particularly in connection with the use of transformers with portable testing instruments, and that is the effect of changes of frequency and of secondary "load." It may be laid down as an axiom that the higher the frequency, and the lower the secondary voltage demanded of it, the better

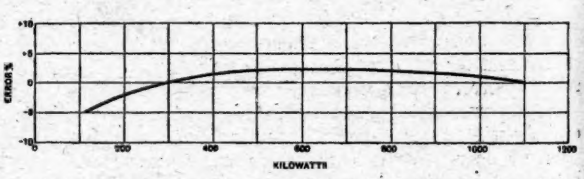


FIG. 5.—ERROR CURVE OF WATT-HOUR METER AND TRANSFORMER.

will be the performance of a transformer. The reason for this is simple, namely, that the satisfactory working of a current transformer, and to a lesser degree of a pressure transformer, depends on the ratio of the magnetising ampere-turns to the total ampere-turns being as small as possible. Any increase in the secondary load, due, for example, to connecting a number of instruments in series, entails an increased secondary voltage, and consequently a larger magnetising current. The effect of varying the frequency is much the same, since for a given secondary voltage, the necessary flux is inversely proportional to the frequency, so that any decrease in frequency entails a corresponding increase in magnetising current.

This is well illustrated by the curves in fig. 6, which show the variation in ratio with changes of frequency and secondary load, in the case of a medium sized current transformer designed for a normal output of 10 volt-amperes at full current. It will be noted that at this output, the ratio error is negligible at all frequencies down to 25 cycles, and that up to 40 volt-amperes, the ratio error is very nearly inversely proportional to the frequency; or, in other words, the percentage error at 50 cycles is, roughly, twice that at 100 cycles, while at 25 cycles it is twice that at 50, and

so on. In the same way the ratio error is, up to, say, 40 volt-amperes, very nearly proportional to the secondary load.

No hard-and-fast rule can be laid down as regards the secondary output to be allowed, since the load which a current transformer will satisfactorily carry depends entirely upon its design, but, as a rough guide, it may be said that in the case of a current transformer used with a wattmeter or watt-hour meter, the secondary load should not exceed 7·5 volt-amperes at 50 cycles (*e.g.*, 1·5 volts at 5 amperes); for an ammeter, 15 volt-amperes; and for a relay, 25 volt-amperes at the same frequency. With a view to economy, these figures are often very considerably exceeded by switchboard designers, with a consequent loss of accuracy, and for

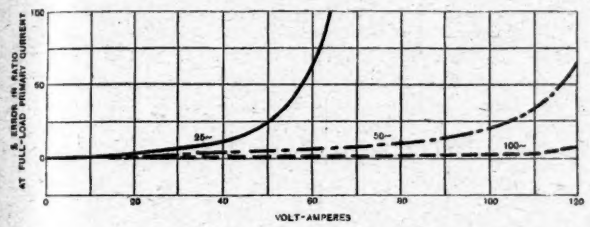


FIG. 6.—EFFECT OF FREQUENCY.

this reason it is to be hoped that the Engineering Standards Committee may see its way to standardise instrument transformer ratings. One simple method would be to rate the transformers according to the number of secondary volt-amperes, which could be taken from a transformer without a deviation from the declared ratio exceeding 1 per cent. of the full load, at any point down to one-fifth of the rated maximum current. Instrument transformers might be further classified according to the phase difference introduced at this output.

From what has been said, it would appear that, *given satisfactory design and rational precautions as regards range and secondary load*, the errors introduced by the use of current and pressure transformers with measuring instruments are so small as to be negligible in practice. Moreover, the ease with which the range of an instrument can be extended by such means is so great that other and often much larger errors inherent to the use of measuring instruments at the lower limits of their scales can frequently be obviated by their use.

There is a tendency, at the present time, to regard instrument transformers somewhat in the way in which wattmeters were regarded six or seven years ago, namely, with a certain distrust, and this apparently for much the same reason, namely, that the principles underlying their construction are not fully understood. It seems safe to prophesy, however, that now that really satisfactory transformers are obtainable at a reasonable price, scepticism will disappear in their case, as it has done in that of wattmeters.

FAULTY ARMATURES.

BY W. H. F. MURDOCH, B.Sc.

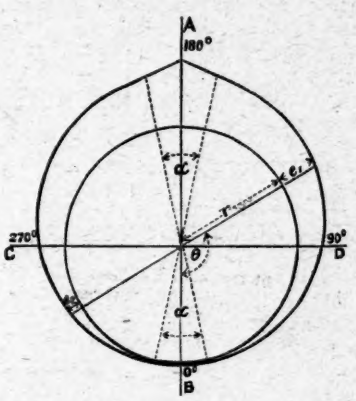
IT frequently occurs that owing to defective insulation there may be faults between the armature windings and core, or between commutator segments and shaft. Under certain circumstances the insulation may have a very low value indeed, and yet the dynamo, or motor, will give practically no indication that anything is wrong until a measurement of the power absorbed at light load reveals it.

In the case of a faulty commutator, if the machine is run at light load for a few minutes, the faulty places can be located by observing the local heating. These can then be marked and further tests made.

In the case of faults to the core, more or less heating will occur, and to locate these the commutator would require to be disconnected from the windings at several places.

If for the sake of simplicity we assume a Gramme winding, and as is usual a spiral distribution of E.M.F., it becomes necessary to examine a few cases as illustrations of core and commutator faults.

In the case of two faults at the opposite ends of a diameter, we see from the figure below that as the armature rotates there is generally a difference of E.M.F. between them. This is represented in the diagram by the difference between e_1 and e_2. When the faults lie on the line C D no current will flow between them or the core, since the potentials are equal, and when the faults lie on the line A B the current between them



is a maximum. We notice that as the armature rotates the current alternates in direction about the diameter A B, but always flows from the upper to the lower portion of the armature core.

In such a case, if the distribution be a spiral one, we might write for the instantaneous value of the difference of the E.M.F.'s, $e_1 - e_2$, or,

$$\Delta \varepsilon = e\,\theta - e\,(\pi - \theta),$$
$$\Delta \varepsilon = 2\,e\,\theta - e\,\pi,$$

where $e\,\pi$ is the maximum value at A in the figure, e being E.M.F. per unit angle.

The average E.M.F. acting between the two segments in such a case is then $\Delta\,\varepsilon_{av} = e\,\pi/2$.

The current flowing in a motor or dynamo armature core between two such faults, if the resistance between them was R, would be $E/2\,R$, and power dissipated $E^2/4\,R$, where E is the terminal E.M.F.

If now the two faults are separated by an angle a, we see that the instantaneous P.D. between them is now—$\Delta\,\varepsilon = e\,a$. When, however, one or other of the faults crosses the line A B (see figure) the P.D. diminishes, and is zero when they are equidistant on either side. It then increases at the rate e per unit angle, until when $a/2$ is reached, the value is again that given above. When the following point is again reached, the same changes occur.

We see, therefore, if two faults are close together, and the P.D. between them only a fraction of the total, that even in the case where the resistance between the faults is only a few ohms, the current need not necessarily be very great. Evidently faults close together are preferable to diametral faults, and the current flowing depends on the E.M.F.'s and resistances, and whether there is an odd or even number of faults.

Again, in the case of three faults making, say, a small angle a with one another, if the resistances are all the same, the current will be proportional to $\Delta\,\varepsilon = 4\,e\,a$. When, however, the line A B is reached by the first fault, the current diminishes, and when the middle fault is on the line A B, it will now flow from the middle fault to those on either side of it. One sees, therefore, that the currents between the faults alter in direction on passing through A B, and for the remainder of their path have the total value given above.

In the case of two diametral faults we see that the current increases from zero to its maximum value in $1/4\,N$ seconds, or if the two faults are a fraction a of the periphery apart $a/2\,N$ seconds, where N is revolutions per second.

If the probability of breakdown depends directly upon potential difference and frequency, it would appear that faults of the diametral variety would be the most common.

Multipolar dynamos would be more subject to them, other things remaining the same, than two-pole dynamos or motors.

In the case of bad diametral faults, the sparking would be periodic, and the "trailing" commutator segment would probably be marked.

It is also easily seen that a breakdown, or partial breakdown, of insulation, either on armature or commutator, or both simultaneously, causes the resistance of the dynamo or motor between brushes to be a varying quantity. The effect of this on the working of the dynamo, or motor, will of course depend on the magnitude of the fault and the type of armature, and would require a considerable amount of space to discuss thoroughly. It will be noticed, however, that the ordinary expressions for terminal voltage would have to be supplanted by more accurate expressions in such cases.

LIVE WIRES AND ACTIONS FOR NUISANCE.

CASES relating to the liability of electric supply authorities for negligence and nuisance arising from live wires are few and far between in this country. Nevertheless, a trolley wire sometimes falls and does damage. Who is liable in such circumstances? The case of Holmes *v.* Municipal Council of Newcastle, which was recently heard in Newcastle, Australia, throws an interesting light on this question.

An action was brought by William Henry Holmes, a painter, to recover the sum of £2,000 as compensation for severe injuries sustained by him through coming into contact with live electric wires. He averred that the accident was caused by the careless and negligent method in which the Council had erected and maintained the wires in question. The first count of the plaintiff's declaration charged defendants with being guilty of a public nuisance, and the second alleged that the Council was negligent in the way stated. It appeared that the Council put up certain live wires along which it conducted electric currents, and it was said that the way in which that was done constituted a public danger and nuisance. Then, the Council was grossly negligent in the way in which it maintained the installation. The accident out of which the action arose happened on a balcony. The balcony was covered by a corrugated iron roof, and one wire was carried about 2 ft. above this roof, and the other 5 ft. above it. The wires were then stretched across the street to the opposite building, and this method of installation had apparently been in existence for some years, though the system had since been altered in such a way that nobody was likely to be injured by the electric current. On Jan. 19th of last year plaintiff had been instructed on that day to make some repairs to the roof of the balcony. He was quite ignorant that the wires were "live," but he endeavoured to avoid contact with them. One of his men was working about the centre of the balcony, and plaintiff stooped down to give him instructions. Upon straightening himself up immediately afterwards, he felt a terrible electric shock pass through him, and became unconscious. A message was at once sent to the electrical depôt, and, the current being cut off, plaintiff was released. He was not dead, and was conveyed to the hospital, where he remained for five months. He received a severe burn on the back of the neck, upon which the scar still remained, and he now suffered constantly from pain, headaches and sleeplessness. Two fingers of the left hand had to be amputated, and two were twisted, and of the right hand only two fingers were left. The medical opinion was that another operation would be necessary, and that part of the left arm would have to be removed from the elbow downwards. It was alleged that the Council had no right to place these wires in a position where they might come into contact with anyone, and by doing so it was guilty of creating what in law was a nuisance. The Council could have placed the wires at such a height as to be out of the way of anyone working underneath them, and they should have been insulated so as to minimise the danger of installation. Apparently the wires had originally been insulated, but had been allowed to get into such a state of disrepair as to become dangerous.

In the event, the jury awarded him £1,275.

Two points will at once occur to those who are familiar with English rather than Australian law. In the first place, the claim was decided by a jury of four. Eight is the minimum in this country. In the second place, the plaintiff was allowed to state in open court what he thought he ought to get by way of compensation for his injuries. He seems to have got a pretty substantial sum.

The law of Australia, as illustrated by this decision, appears to be very similar to that of our own country. A live wire may be a nuisance; and it is certainly not competent for anyone to place that which is a nuisance in a public place. Nor may an electric supply authority which uses *insulated* overhead wires allow the insulation on those wires to become defective. In such circumstances an overhead wire may become a veritable death-trap.

Although cases of this kind have been few in England they have been frequent in America. It has there been decided that one who is travelling along a highway and sees a loose electric wire upon the street, with nothing to show that it is a live or dangerous wire, may voluntarily pick it up and throw it out of the highway, and if the wire is a live wire, and he is injured thereby, he can recover damages, for picking up the wire and throwing it out of the way is an incident of travel along the highway, and is not contributory negligence on the part of the traveller.

The extreme care which must be taken in looking after these wires is illustrated by another case where a guy wire of an electric light pole, becoming loose, fell upon another guy wire of another pole, which in turn fell upon the trolley wire of an electric railway, and these wires were charged with electricity; a boy who was going along the street picked up one of them and threw it to one side, and was killed while so doing. It was held that there was sufficient evidence of negligence of the electric light company in the looseness of the wires; and that it was not contributory negligence for a boy to pick up an electric light guy wire when there was nothing to show that it was charged with electricity from the railway line.

Of course, where there are wires stretched across the highway, it is only those who are using the highway for a legitimate purpose who are entitled to be protected. Anything in the nature of extraordinary use will not be protected. For instance, a man who flew in an aeroplane along, but a little above, Oxford Street, could not complain if he were to strike against an overhead wire. This point is well illustrated by a further reference to America, in which country the highway is sometimes used for the removal of buildings from one location to another. Such a removal cannot be considered one of the uses of the highway for public travel for which it was designed, and, therefore, if such removal involves the disconnecting of electric wires, it cannot be done unless by consent of the electric company or by statutory authority, which is given in several States. Without such consent or authority, the person so disconnecting the lines is liable to the company for damages, unless the wires are wrongfully on the street, as when they are strung below the height prescribed by the ordinances of the town. When shall we see buildings thus moved about in England?

An Electrically-Fused Steel Plate.—At the annual meeting of the American Society for Testing Materials held recently at Atlantic City, N.J., Mr. A. W. Carpenter, of New York, presented an interesting report giving the result of tests which had been made on a steel plate that had been partly fused by a short-circuited electric current. The electrification of the New York Central Railway involved carrying the third-rail and power conductors over the Park Avenue Viaduct, about 1¼ miles long. The cables were placed in steel tube conduits, just over the tops of the girders, on which the conduits were supported on wooden blocking. A short circuit fused the conduit and burned the underlying coverplate, the burn extending clear through the plate at one point. The metal and the copper cable were fused into the plate; the injured portion was cut off and replaced with a new plate, and tests were afterwards made to determine how the strength of the plate had been affected. These tests showed that the injury did not extend far beyond the limits of the visible burning. The change was enough to reduce the static strength of the plate tested some 40 per cent., and to destroy its ductility. It was concluded that a plate with a similar injury would be unreliable for service, but that if the local injury were cut away, the remainder of the section would have practically the same strength as before.

ELECTRIC POWER SUPPLY IN SOUTH AFRICA.

II.

In the preceding article which dealt with this subject, we purposely stopped short at considering the recommendations of the Commission, because it had been freely rumoured that the Victoria Falls Co. had been able to secure very important modifications in the proposed legislation. This has proved to be true, for the chairman of the Victoria Falls Co., at the annual general meeting, held on the 15th inst., announced that very important amendments had been obtained. Quoting from the chairman's speech, "The Power Undertakings Act of 1910 contains no provisions which are calculated to prevent the carrying on of your business so as to secure for you the return upon your investment which you have a right to anticipate." Unfortunately, we are in total ignorance of the value of these amendments, and we must remain so until the full text of the Bill is available. If, however, the Victoria Falls Co. is satisfied, we presume that it has been able to obtain terms which are adequate to cover the expenditure entailed by the extraordinary scheme put forward in the original prospectus. The preferent right to the Victoria Falls, including, we believe, the wonderful hydraulic accumulator of Mr. H. Wilson Fox, cost the company £1,120,000. This vast expenditure has so far yielded no advantage, and we venture to prophesy it will never have the slightest influence in cheapening the cost of electricity on the Rand. The annual value of this sum at 5 per cent. is £56,000, and we hope the Minister of Mines for South Africa realises that when the Victoria Falls Co. declares itself satisfied with the new terms, it has obviously included the abortive capital expenditure in its general consideration. Either the present and potential consumers of the Rand must pay this £56,000 or the Victoria Falls Co.'s shareholders will suffer.

Without the new power Bill before us, it is impossible to pursue further this phase of the subject, and we therefore turn to a consideration of the probable effects of cheap electric power upon the South African industries. It is admitted by the Commission that the advantages claimed for the generation and sale of energy in bulk have now become so apparent, and the prices quoted by the power companies have reached so low a figure, as to overcome the doubts entertained until recently by prominent financiers and engineers. The question of security as regards continuity of supply was considered by the Commission, and the evidence put forward was such as to show that failures were of rare occurrence. While the duplication of machinery and lines may do much to minimise interruptions, we are very much afraid that if the owners of the Rand mines are under the impression that a bulk supply will give them absolute immunity from trouble they are likely to have a very rude awakening. The experience in this country of bulk supply—which is, after all, fairly extensive—shows that while interruptions in supply are comparatively limited, they do occur, notwithstanding extreme vigilance and skill, and it has to be remembered that the conditions of supply in South Africa are not likely to be as good as those obtaining here. At the same time there is abundant evidence of the value of bulk supply, and the Commission gives an example of the City Deep, which is held to be typical of many others. In this case it is estimated that after having already spent £225,000 upon its own plant, the company will require to spend only an additional £436,000 if it carries out its intention of purchasing power, whereas if it had preferred to generate its own power, it would have had to spend an additional £560,000, being a difference of £124,000 in favour of purchasing electric power. While the Commission is satisfied that the City Deep is typical of all new companies still to be equipped, one would have been more satisfied if the actual evidence had been available on which such a statement was based. It is not difficult to prove that many mines would be better off when purchasing power from an outside source, particularly when the limitations of life are taken into consideration; at the same time it by no means follows that it is going to be an economical arrangement for every mine. It is a question that each mine must settle for itself, bearing, of course, in mind that the cost per KW.-hour is not the only consideration. From the statements made by the Commission, based on the evidence offered, there is a danger of making too much of a fetish of bulk supply, and certainly in some cases the standard of comparison between the cost of a private supply and that of one from outside is not a correct one. To demonstrate what we mean, we will quote a paragraph from the report:—

"The evidence before the Commission shows that, owing to the lower rate at which power could be supplied by the power companies as against its generation on the mines, a saving variously estimated at from 6d. to 1s. per ton may be anticipated. It has been shown that the energy consumed per ton of rock crushed on the Rand amounts to about 27 KW.-hours or Board of Trade units. The average cost of generating energy by steam was found for 12 mines of the Rand Mines Group to amount to ·918d. per unit, equal to 24·7d. per ton crushed. On the basis of the price at which current is proposed to be sold to the Rand Mines—Eckstein Group—namely, at ·525d. per unit, the cost of power would be 14·2d. per ton crushed, or a saving of 10·5d. per ton. A similar result is arrived at by using other bases of comparison. It may also be expected that, owing to the better control and knowledge of the amount of current consumed, greater care will be taken in its use, and further economy may result therefrom." In this case we are offered a comparison of ·918d. per unit as against ·525d., which, on the face of it, appears overwhelmingly in favour of bulk supply. But surely we are not expected to swallow the statement that the Rand Mines could not have done better than ·918d.; their plant was probably capable of some improvement, but what has been completely lost sight of is that the load and the load factor are totally different in the two cases. If the Rand Mines Group had done with its own supply what it proposes to do with the bulk supply, then we should not have had this apparently wide difference in cost. If the two cases had been put on exactly the same basis probably the bulk supply would have presented greater advantages, but it is very much to be deplored that untrustworthy comparisons should be set up.

While we have freely criticised many of the statements put forward by the Commission, which statements are without doubt based wholly on the evidence of engineers and other persons more or less interested in the question, it is gratifying to find the Commission is satisfied that the supply of cheap electric power to the mines will on account of the economic and other advantages adduced help to lead to an expansion of the mining industry. While the evidence given before the Commission does not enable it to form an estimate of the additional quantity of ore likely to be brought within the pay limit by the reduction in working costs, yet it is clear that every reduction must bring more ore within this limit and thus lengthen the life of the mine and the gold field. The reduction in capital expenditure enables an immediate expansion to take place in that the available cash capital of the mining company can be utilised for erecting a larger crushing plant than could otherwise be installed.

The Commission deals at considerable length with the effect of power supply on the coal industry. It strikes one at the first glance as somewhat remarkable that the Coal-Owners' Association appeared before the Commission to urge that although they do not propose to stop progress or controvert the arguments in favour of the introduction of electric power, yet they ask for some protection against a disturbance in the balance of the coal trade and a reduction in the consumption of coal, while the Commission very gravely produces voluminous evidence to show that notwithstanding the greater economy effected by the introduction of electric power, the consumption of coal in the future will be greater than it is at present. This naive assumption of innocence on the part of the Commission we presume deceives nobody; the Coal-Owners' Association did not care a jot for that aspect of the case, but they were much perturbed that the Victoria Falls Co. should erect a power station on the Vereeniging Estates, thereby disturbing the balance of the coal trade. In other words, the proprietors of the Vereeniging Estates had scored heavily over the rest of the coal owners, and the reply was to attack the Vereeniging site on the grounds of its unsuitability. Again, the Commission gravely defends it, and further says, "the action of the Victoria Falls Power Co. in arranging for a long contract with the Vereeniging Estates, who have their collieries in the immediate neighbour-

hood, may be regarded as an ordinary business precaution to prevent prices being unduly raised against them later on owing to their distance from other competitive collieries." We should put the reason in fewer words, and say it is due to the presence of Mr. Isaac Lewis on the board of the Victoria Falls Co.

The Commission considers the effect of bulk supply on railways and other industries, but the conclusions are not particularly illuminating. The rest of the Report deals with powers and restrictions, but as these are covered by the new Bill on power supply, it is hardly worth while referring to them.

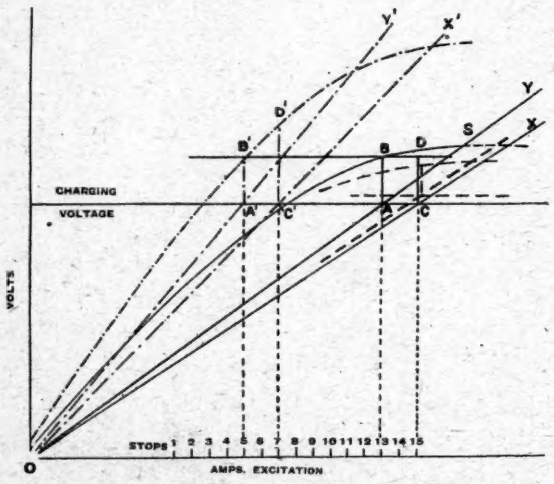
CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Commutator Troubles.

It would appear from a close observation of the peculiar behaviour of the dynamo mentioned by "Also Worried," that the trouble is due to the insufficient speed of the machine, and an attempt to secure a charging voltage by increasing the shunt current, as deduced from the first charging position of the shunt rheostat.

Referring to the accompanying diagram of an imaginary "E.M.F. and excitation" curve for a shunt dynamo, the most remote point which would be reached in practice would be at, or near, S, where saturation of the magnets causes it to



A B, C D, A' B', C' D', equal (E.M.F. — terminal voltage) or C R_A drop at the point, and, neglecting the shunt currents, are directly proportional to the charging currents.
O X, O Y, O X', O Y', show rise of volts, with current increase, across the field circuit for four positions of the rheostat.
A C and A' C' are identical increases of exciting current.
——— Characteristic curves for present speed at beginning of charge.
— — — Modified curves for same speed, an hour later, showing effects of heating and rise of battery E.M.F.
— · — · Characteristic curves for speed increase of about 30 per cent.

assume a horizontal direction. For an explanation of the peculiar behaviour noticed, an assumption is made that the last one or two stops of the shunt regulator result in the machine working in the vicinity of S; and a feasible explanation, granting this, is as follows:—

On referring to the full-line curves, which may be taken to represent the conditions at the commencement of charging, with the present speed, the current being sent into the battery is represented by the height A B (see note under diagram), and is, in the case mentioned, about 120 amperes. Now, basing our assumption on the foregoing, "cutting out" another stop on the rheostat, or even two, tends to increase the charging voltage and current but very slightly; in fact, after the first hour or so, due to heating, &c., ill-effects of the excessive sparking, natural under these conditions, and rise of battery E.M.F., the characteristics would have to be modified, as represented by the inset dotted portion, and a very noticeable *decrease* in the charging current would result.*

On increasing the speed, a new aspect of things presents itself. A reference to the second curve, which is the result of an increase of about 30 per cent., shows—first, that fuller use may now be made of the rheostat: the handle may be brought much further back to obtain the necessary charging conditions, as shown by the more abrupt rises of O X' and O Y' as compared with O X and O Y, which latter were adapted to the former conditions. The "warming up" of the shunt will also be greatly minimised, and the consequent heating effects reduced. "Cutting out" stops on the regulator now tends to materially increase the charging current as at A' B' and C' D', since the machine is working well on the rising portion of the curve. As the battery volts rise, so the dynamo volts may be raised; and it is possible that the battery may be fully charged without cutting out the last one or two stops.

The definite increase in speed should be a matter of experiment for "Also Worried"; and, doubtless, in so doing, he will be going in the right direction for minimising his troubles.

W. T. Hilder.

Corporation Electricity Works, Swindon,
July 20th, 1910.

In your issue of July 15th I notice a query by "Also Worried" *re* commutator troubles, and, if not too late, I hope the following reasoning will be of service to him.

I understand from his letter that everything is satisfactory at commencement of charge, therefore the plant is, under light-load conditions, satisfactory; but as the battery voltage rises, due to charging, and all resistance is taken out of the shunt rheostat, the charging rate drops from 120 amperes to about 50. The drop in charging indicates that the voltage of the dynamo has not been increased in proportion to the battery voltage. The resistance having been taken out of the shunt, an increased current flows through it, giving rise to a greater magnetic effect, and so requiring more power to drive the dynamo at the same revolutions and raise the E.M.F. of machine. The speed of the dynamo being the only variable quantity to affect the E.M.F., if the engine speed is kept constant, I propose to look to the pulley for the defect. The pulley has been called on to transmit more power from engine to dynamo, and if the belt is too slack the conditions are favourable for increased slip and a corresponding drop in the speed, which can be detected by taking the revolutions at commencement of charge and again when fault develops; I take the other faults as secondary to the above.

C. W. Westwood.

H.M.S. *Cochrane*,
July 23rd, 1910.

Prevention of Rust.

Mr. A. J. Bousfield has rendered a service to engineers by the way he has put the results of his experiences before them in his two letters. It would be an advantage if other engineers would also give their opinions on the best method of overcoming what must be admitted to be a very serious evil.

With the bulk of Mr. Bousfield's letter, we find ourselves in entire agreement. There is no doubt that, as he says, the formation of zinc compounds, which act as a protection, is of much value, as is evidenced by the effectiveness of good galvanising. Unfortunately, however, the same process has undoubtedly much to do with failure where the galvanising is not of the best.

The amount of iron which, in galvanising, is dissolved in the zinc bath becomes a portion of the coating and, acting

* In the formula $C = \frac{V - E}{R_B}$, where C = current; V = terminal volts; E = battery E.M.F.; R_B = battery internal resistance; where R_B is small, a slight increase or decrease of V causes a very large increase or decrease of C respectively.
Also, due to sparking and the resulting condition of the commutator, a somewhat increased resistance of the armature circuit would slightly assist in a reduction of the current, and a new value of R_A must be applied to the inset C R_A portion.

as a carrier, brings about the destruction of the protecting layer.

With regard to the question of the organic acids having a beneficial result, it appears to us that the theory of more intimate contact of the preservative due to their action requires considerable confirmation before it can be definitely accepted, especially in view of the frequency with which tar compositions give trouble by flaking off in patches.

We think, however, that we are on common ground with Mr. Bousfield in maintaining that the present method of protection by means of linseed oil paints is wrong.

When iron began to supersede timber as an engineering material, linseed oil paint, which had been from time immemorial adopted in connection with timber, was used for similar service in connection with the new material, apparently without question, and as the earliest structures were chiefly of cast-iron, on which the rate of corrosion was very slow when exposed in the majority of cases to an atmosphere charged with much less acid products of coal combustion than are present under modern conditions, it was quite reasonable that for many years linseed oil paints were found to be sufficiently effective; but recent experience of the older wrought-iron, and, what is still more serious, of the new steel structures, has shown, we think, that unless more efficient means of preservation be forthcoming, renewal costs may become a very serious question in the near future.

This must explain our reference to the "Anthrol" compositions in our previous letter, as these appear to be a good solution of a great difficulty. A trial can easily be made on some steelwork erected sufficiently long for the mill scale and first coats of paint to begin rusting off the metal, or upon new work constructed of material which has lain prior to erection sufficiently long for incipient rusting to detach the mill scale from close contact with the metal.

Until this mill scale can be completely detached, it is useless to attempt the application of a permanent protective coating. Whatever medium may be used to cover structural steel while the mill scale is still adherent, the work will have to be repeated in a comparatively short time.

Pro **Fount.**
W. ORMROD.

Newcastle-on-Tyne, *July 20th*, 1910.

Steam Regenerative Accumulators.

The attention of my clients La Société d'Exploitation des Appareils Rateau has been drawn to a report which has appeared in the Press of a decision of the Solicitor-General, in the matter of the opposition which my clients entered to an application for letters patent by Mr. D. B. Morison, for an invention relating to steam regenerative accumulators.

Inasmuch as this report may possibly lead to a wrong inference on the part of the public, I would ask your courtesy to be allowed to point out that the above-mentioned decision only involved the question whether or not Mr. Morison ought to refer in his specification to one of my clients' prior patents. Neither the question of the validity of, nor any question as to infringement of, my clients' patents was raised or could have been raised, in these proceedings before the law officer, and this decision of his in no way affects the rights already acquired by my clients in respect of the steam regenerative accumulator invented by Monsieur Ratean, which rights my clients will at all times seek to maintain.

L. Melville Clark.

London, W.C., *July 23rd*, 1910.

Salaries in India.

Your correspondent who signs himself "Garden Reach" in your issue of June 24th, may have had a large experience of India, but I am afraid that his knowledge of supply stations and their customs is rather limited, as his statements as to the salaries attached to various posts are very misleading. As regards resident engineers, it is impossible to give any reasonable limits to the salary that may be attached to the post. I happen to be personally acquainted with the resident engineer of one of the first five public supply companies in this country, which has about 1,000 H.P. installed for tramways and lighting, and he is in receipt of a salary of only £360 per annum, his subordinate staff being paid in proportion. As for shift engineers and foreman fitters, I could obtain a large supply of really qualified men at anything from £120 to £200 per annum. Of course, there are cases of men with exceptional ability whose services are so valuable that they have had their salaries raised to as much as £300 per annum; but to pay more than this amount to a man filling a subordinate post such as this could only be designated as bad management. Personally, I do not consider that any European from home should accept any post in a supply company in this country except as head or first assistant in his department, as the country has sufficient supplies to fill the really subordinate posts.

An Old Hand.

Japanese Government and British Manufactures.

Referring to our letter which appeared in your issue of May 13th last, we find that we made an error in reporting what Count Komura said regarding the best-favoured-nation clause. Mr. E. F. Crowe, British commercial attaché in Japan, who is now in England, tells us that what Count Komura actually said was that "no *unconditional* best-favoured-nation clause would be granted." This slightly alters what we said, although it makes but a small difference. However, we shall be glad if you will kindly make the necessary correction, as we would be very sorry to think that by making a slight mistake of this kind we might be accused of trying to twist what had been said by a responsible statesman.

British Importers.

Japan, *July 9th*, 1910.

Lightning Conductors.

My quotation from Sir Oliver Lodge's book was carried as far as it was a completed statement to the effect that the bending back of a conductor on itself, so that the current passes in opposite directions, largely neutralises the inductance. The context does not in any way alter or modify this fact. The part that you have put in italics, and to which you appear to attach a great deal of importance, may be read in more ways than one.

It may be a declaration that a conductor should be fixed in a dead straight line, or it may be intended, in its wider sense, as the antithesis to the close zig-zagging to and fro that experiment shows to be advantageous in reducing inductance, but which, for other reasons, cannot be adopted in the practical application of lightning conductors. I think anyone who has studied the book as carefully as I have done would conclude that the latter is the intended meaning. Were it intended in its limited, and strictly literal, sense, it would be an arbitrary assertion that Sir Oliver Lodge does not justify in any part of the work, that would be impossible to comply with, and that would not be consistent with the suggestions he has put forward for the application of lightning conductors.

It may be suggested that it means a conductor should be as straight as possible, or as convenient, but a conductor with a bend in it is either rendered inefficient by that bend or it is not; and if it is the bend which constitutes inefficiency, its position in the conductor must be immaterial. Therefore one conductor that had an unavoidable bend could not be claimed to be more efficient than one with a similar bend, which might have been avoided. Possibility and convenience have nothing to do with the question of efficiency, and should not be made a proviso by anyone who desired to have conductors efficient.

Your selection of a chimney shaft as an illustration is not a very satisfactory one, for, as a rule, this is one of the easiest types of structure to protect, and a conductor on it might prove an effective safeguard, even if it had faults that would render it inefficient as a protector for a more complicated type. There are, of course, exceptions; but in most cases inductance is a factor that an expert would not require to take into account. On comparatively small shafts conductors can, in some cases, be fixed without bends; but on

large ones and buildings of other kinds they are generally unavoidable, and on most it would be impossible to fix conductor systems in accordance with the recommendations of Sir Oliver Lodge, Lord Kelvin, or other theoretical writers, without having bends.

There is on record a solitary case—over 30 years ago—in which very slight damage was caused to a moulding to which the conductor had been very closely dressed. On the other hand, I am of opinion that, if the conductor on the east chimney of the Royal Horticultural Hall (referred to in my letter in the ELECTRICAL REVIEW of July 15th) had been fixed in a different way, so as to have necessitated two bends in it, the damage would not have occurred.

The question of bends, such as your correspondent "W. H. B." referred to, is of such little importance that I should not have troubled to challenge the statement, whenever made, if it were not that, by being given unwarranted prominence, it is likely to obscure more important considerations on which efficiency does depend. For this reason I am anxious to see the matter thoroughly thrashed out.

Alfred Hands.

London, E.C., *July 25th*, 1910.

[We understand Sir Oliver Lodge's parenthetical remark to have been intended to make it quite clear that, in demonstrating the non-inductive properties of a compact zig-zag, he did not wish it to be supposed that such a zig-zag could possibly be used for the purposes of a lightning conductor. The beginning and end of a non-inductive zig-zag must be as close together as possible, and our reference to a tall chimney was made to point out the impossibility of fulfilling this condition in such a case.

We do not see what other meaning can be attached to the phrase "a lightning conductor must, of course, be straight," than the literal meaning of the plain English employed. Any departure whatever from the straight line between two points increases the self-induction of the conductor joining them. We agree, of course, that more often than not the condition cannot be completely fulfilled in practice; but it represents the ideal to be aimed at, and the deliberate introduction of superfluous bends into a lightning conductor, so far from reducing the self-induction, must inevitably increase it, and therefore increase the tendency to side-flash.—EDS. E.R.]

The Association of Consulting Engineers.

As a consulting engineer who is not a corporate member of the Institution of Civil Engineers, I should like to express my gratitude to you for your trenchant criticism of the "taboo" which the proposed Association of Consulting Engineers are placing upon all those outside this magic circle.

Looking at the matter from the personal point of view, I fail to see why I should be branded as an outsider because I do not happen to belong to the Institution of Civil Engineers.

In the days of my youth I joined the Institution of Electrical Engineers, with the idea that to become a full member of that body was the highest qualification in our branch of the engineering profession, short of the Fellowship of the Royal Society. I am bound to admit that, as time has gone on, one has become more and more disillusioned as to the Institution of Electrical Engineers representing the pulse of the electrical industry of whatever branch, but the final blow is to find that amongst the most active leaders of the new movement are members of Council and former Presidents of the Institution of Electrical Engineers, who have been assuring us all along that our Institution is going to be on top.

I seem to remember that at the meeting held to sanction the acquisition of the new building on the Embankment (at which I was one of the minority who voted against the scheme), the then president, and others of the Council, sugared the financial pill which they asked us to swallow, with the assurance that it only needed the new building to make our Institution as great, or greater, than the Civil's, and yet they are now the very people who deliver us into their hands.

The more the new association flourishes (and, if constituted on fair lines, it should have the support of every consultant) the greater injustice will be done to those who are excluded by the arbitrary test proposed.

Were it not farcical, in view of the founders of the Association, I should propose for the credit and honour of the Institution of Electrical Engineers, that the Council should approach the promoters of this new Association, with a view to securing equality of treatment for those of their members who are in the consulting branch of the profession. Apparently, however, the advocacy of the Press is all that is left us, and I trust it may meet with the success it deserves.

Harold W. Couzens.

London, S.W., *July 25th*, 1910.

A SENSITIVE ELECTROLYTIC DETECTOR WITHOUT AUXILIARY ELECTROMOTIVE FORCE.

RADIO-TELEGRAPHY has been using for some time past a novel type of detector which, in direct connection with telephone receivers, allows Hertzian waves to be revealed without the intermediary of any auxiliary electric generator. To this category belongs mainly the perikon, of which the silicon is the immediate outcome. In principle these detectors are formed by combining pyrites or crystals of chemical elements with very fine metal points, the contact of which is submitted to a suitable pressure.

While as sensitive as the best detectors known, these instruments are liable to get out of order very easily, and require more or less laborious adjustment, the more so as certain phenomena of insufficiently elucidated nature have been found to play some part in this connection. A French engineer, M. Paul Jégou, has been engaged during the last few months in designing a liquid electrolytic detector, which is capable of working without the aid of any auxiliary source of energy. In these endeavours he was guided by some results that had been obtained in connection with electrolytic detectors constructed on familiar lines, except that the cathode was a fuse wire consisting of lead, with a slight addition of tin. In the interior of these detectors a slow chemical action goes on, setting up a weak electric couple, which suffices to sensitise the

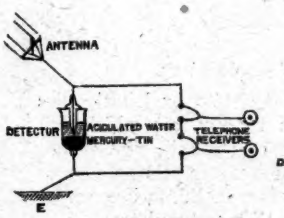


FIG. 1.—DIAGRAM OF CONNECTIONS FOR DIRECT RECEPTION.

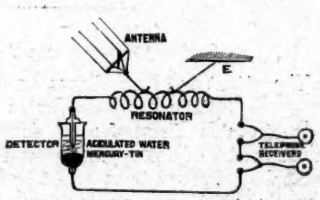


FIG. 2.—DIAGRAM OF CONNECTIONS FOR INDIRECT RECEPTION.

active point, and this, in opposition to the general case, acts as cathode. The active electrode is connected externally with the lead electrode of the detector through the intermediary of the telephone receivers, which record the passage of electric waves in the usual manner. The most satisfactory results are obtained with high-resistance receivers, such as those of the Sullivan type.

These detectors are of remarkable sensitiveness, and irreproachable regularity in working, their sensitiveness being practically constant. Though not indispensable, the alloying of the tin and lead has been found very effective in connection with these instruments. These observations led to the construction of electrolytic detectors of even higher sensitiveness, which are able to compete with electrolytic detectors associated with an auxiliary source of electricity, according to the customary arrangement.

These novel detectors are characterised by more covenient choice of the inactive electrode, which consists of mercury containing some pure tin in solution. Water, acidulated with sulphuric acid, is poured on to the mercury, which occupies the bottom of a cylindrical glass vessel, traversed at the bottom by a platinum wire, serving as external electrode, which communicates with the mercury-tin electrode. Into the acidulated water dips the sensitive point, which is similar to those of ordinary electrolytic detectors.

By connecting the detector directly (fig. 1) to the terminals of the telephone receivers (*e.g.*, of the Sullivan type) and to the antenna earth circuit according to a direct or indirect arrangement, as generally used, the inventor was able to obtain satisfactory results. The sensitiveness of the apparatus is such that the wave-trains daily received at the Ouessant station of the Postal and Telegraphic Department (such as those coming from Algiers, Saintes-

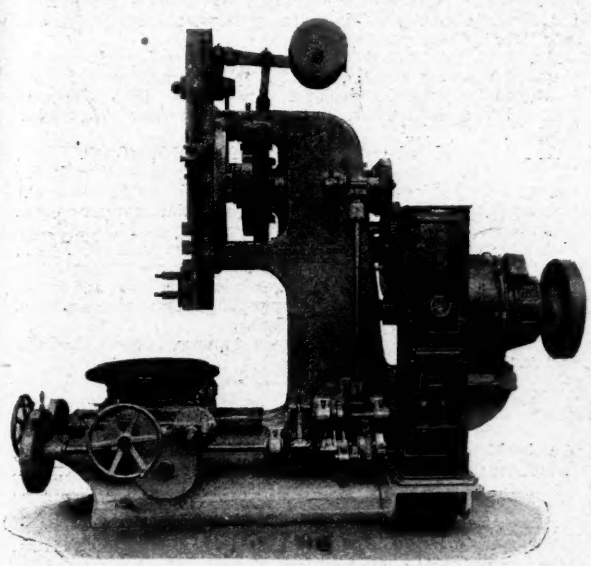
Maries-de-la-Mer, Clifden, Eiffel Tower, Rochefort, Cherbourg and various ships) can be detected by its means.

In the case of this type of electrolytic receiver, all the constituent elements are accurately known, and the adjustment does not depend on any obscure phenomena.

A syntonised arrangement, with which excellent results were obtained, consists of connecting the tuning resonator in series with the detector and telephone receivers, according to the diagram given in fig. 2. In this case the output was decidedly higher than with the arrangement generally used, according to which the resonator is coupled to a condenser, the whole system being connected to the terminals of the detector. The receiver is reduced to the organs strictly necessary, viz., on the one hand the device sensitive to Hertzian waves, and on the other the apparatus for revealing the action of the waves on the sensitive organs.

MACHINE TOOLS AT THE JAPAN-BRITISH EXHIBITION.

AN exceptionally fine series of electrically-driven machine tools is exhibited by Messrs. Sir W. G. Armstrong, Whitworth & Co., Ltd.; it includes a high-speed self-acting sliding and surfacing lathe, a slab milling machine for high-speed cutting, a vertical drilling machine, a self-acting slotting machine, and a combined grinding machine for twist drills, reamers, milling cutters, &c. The lathe has 18-in. centres, and a 20-ft. bed, capable of taking 10 ft. between centres; the gearing consists of machine-cut helical teeth, and the machine is driven by a 60-H.P. motor, running at any speed between 250 and 750 R.P.M. on a 500-volt circuit, with a regulating lever on the front of the lathe. The feed is also controlled by a lever, giving six changes, and every provision is made for facilitating the control of the lathe by the operator. The slab-milling machine is equipped with two motors, one for driving the cutter spindle, of 40 H.P., 200-600 R.P.M., and the other for giving independent feeds to the table, and for quickly moving the table on the bed; the latter



ELECTRICALLY-DRIVEN SLOTTING MACHINE AT THE JAPAN-BRITISH EXHIBITION.

motor is of the reversible type, giving 7 H.P. at 200-600 R.P.M. The machine is of very substantial construction, and is capable of milling a slab 8 ft. × 2 ft. 5 in., and 1 ft. 3 in. high (with a 6-in. cutter). The vertical drill is provided with a balanced spindle, which rises when thrown out of gear, and the feed can be released by a stationary lever instead of the usual revolving catch. A rotary pump supplies lubricant to the drill point. The drill is driven by an 8-H.P. motor running at 500 to 1,600 R.P.M., and capable of giving 15 B.H.P. for 10 minutes; it has a vertical traverse of 9 in., with four feeds, and can take material 18 in. thick.

We give an illustration of the slotting machine, which has a 10-in. stroke, and is driven by a motor of 15 H.P., running at 330-990 R.P.M.; it is fitted with a balanced tool ram with quick return motion, and the table has a diameter of 27 in. The longitudinal and transverse traverses are 27 in. each. All necessary feeds are provided, under easy control. The grinding machine is driven by a 1¼-H.P. constant-speed motor running at 1,340 R.P.M., and a smaller motor is provided for driving a lubricating pump. There are three grinders. In each case the machine is designed for electrical driving, the motor either being carried on an extension of the bed-plate, or, in the case of the grinding machine, inside the latter, so as to form an integral part of the design. The motors were all made at the Elswick works of the company, and are provided with suitable starting gear, with automatic releases where necessary.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

G.E.C. "Witton" Switches.

The GENERAL ELECTRIC CO., LTD., has recently placed upon the market a complete line of chopper switches, to be known as the "Witton" type, manufactured throughout at Witton Works. The switches are made and stocked for from 30 to 1,000 amps. at 600 volts, and larger sizes up to 10,000 amps. can be made up at short notice. The same general design has been carried through the whole range, and the appearance of the switches of different capacities is therefore similar, an advantage which will be readily appreciated by switchboard makers. The switches are amply dimensioned; the current density nowhere exceeds 1,000 amps. per sq. inch sectional area, and 60 amps. per. sq. inch surface area in the contact clips. This low rating allows of the switches being overloaded as much as 50 per cent. permanently without dangerous heating, and much higher for short periods.

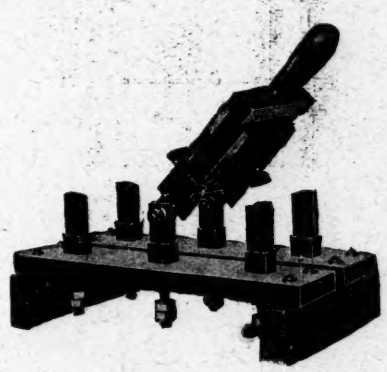


FIG. 1.—G.E.C. "WITTON" CHANGE-OVER SWITCH.

The flipper blades, which give the quick break, are fitted with a steel stamping where they are hinged, and the main blade is bushed with a steel bush for the hinge pin, which makes the actual wearing parts very strong. At the handle end, the main blades up to and including 200 amps. are provided with pressed-steel clips to attach the handle, or, in multiple switches, the bridge. Over 200 amps., solid square steel ends are used. To hold the blade in the "off" position in change-over switches, or where there is no room to swing the switch right over, shaped steel springs are provided, which are fixed to the side of the hinge contact, and act on the rounded end of the flipper blade pivot pin. The switches are stocked "single," "double" and "triple" pole, for front and back connections. All the parts are interchangeable, and the finish is copper and black.

New Tantalum Lamp.

MESSRS. SIEMENS BROS. DYNAMO WORKS, LTD., of Tyssen Street, Dalston, N.E., have placed on the market a new type of tantalum lamp, in a tubular bulb, giving 25 C.P. at 100—130 volts. The bulb

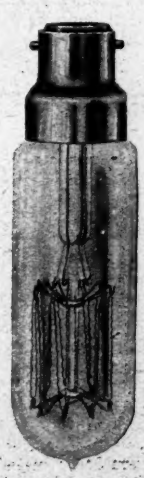


FIG. 2.—TUBULAR TANTALUM LAMP.

is 5¼ in. × 1½ in. diameter, and the lamp has an efficiency of 1·7 watts per candle, burning on either D.C. or A.C. circuits; it is suitable for use in strip-light reflectors for shop windows.

New Flame Arc Lamps.

MR. G. BRAULIK, of 8, Lambeth Hill, Queen Victoria Street, E.C., has introduced new patterns of flame arc lamps, called the "Eclipse" type, for D.C. and A.C., which are claimed to infringe no patents. The construction of the D.C. lamp is extremely simple; the carbons are inclined, but the regulation of the arc is effected entirely from the top of the lamp, the carbons sliding axially in guides. The accompanying illustration shows the arrangement of the controlling gear. It consists simply of a differential shunt and series solenoid, actuating a clutch, through the agency of a lever, against the tension of an adjustable spring. The clutch is of a very peculiar design, having three working parts enclosed in a box; one part is connected to the lever by a link, and presses a T-shaped piece against the chain, while the third part acts in the opposite sense, releasing the clutch when its toe comes in contact with the top-plate of the lamp. The flat chain is also of novel construction, presenting a perfectly smooth surface to the clutch and to the

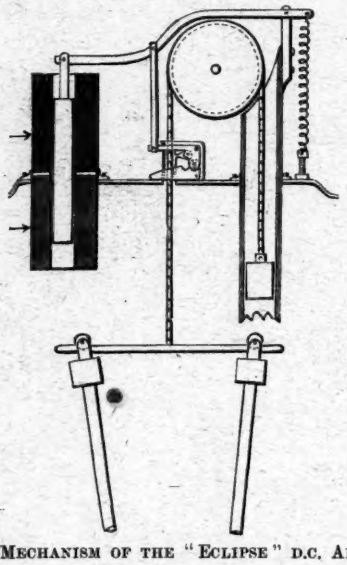


FIG. 3.—MECHANISM OF THE "ECLIPSE" D.C. ARC LAMP.

opposing wall of the box. As shown, one end of the chain is attached to a bar from which the carbons are suspended by rollers, while the other end is attached to a balance-weight enclosed in a tube. This simple mechanism operates remarkably well, as we observed when visiting Mr. Braulik's offices some weeks ago to see the lamp. On closing the circuit the carbons are retracted, striking the arc to practically its normal length, after which they are gradually lowered until the toe of the clutch meets the plate; subsequently the arc is controlled by the clutch, which feeds the chain by almost imperceptible movements.

In the A.C. lamp the carbons are controlled by a simple A.C. induction motor, consisting of an aluminium disk and series and shunt-wound electromagnets; the motion of the disk is transmitted through a train of wheels to the chain drum, which in this case is balanced. In its main features this lamp otherwise resembles the D.C. pattern; in both the mechanism is protected from the fumes emanating from the arc, and ordinary flame carbons are used. Simplicity is the keynote of the mechanism, which is easy to keep clean and in order. The lamps are made for various currents, and burn for 10 hours with one trimming.

LEGAL.

RAILWAY COMPANIES' AGREEMENTS AS TO COST OF ELECTRIC TRACTION.

THE Railway and Canal Commission, consisting of Mr. Justice A. T. Lawrance, Sir Jas. Woodhouse and Mr. Gathorne Hardy, decided a dispute, on Wednesday last week, between the Metropolitan and Great Western Railway Companies. The question raised had reference to the basis on which the Great Western Co. were to pay the Metropolitan Co. for the supply of electric traction.

The Great Western Co. had powers over the Metropolitan Co.'s system from Bishop's Road to the City, and paid £15,000 per annum for the privilege. The Metropolitan Co. obtained an Act in 1898 empowering them to substitute electric traction for steam locomotives. It was provided that if at any time they should required the Great Western Co. to make a similar substitution, the question of cost should be referred to arbitration.

The Court held that the arbitration clause of the Act was passed for the protection of the Great Western Railway Co., and that the cost to be borne by that company was the cost they were put to for steam traction.

It was arranged that the form in which the decision of the Court should be drawn up should be agreed upon by counsel and submitted to the Commissioners.

MOTORS AS TRAMWAY FEEDERS.

IN the Court of Appeal, before the Master of the Rolls, Lord Justice Farwell and Lord Justice Kennedy, judgment was given in an appeal of the defendants from a judgment of Mr. Justice Lawrance in the case of the Bristol Tramways and Carriage Co., Ltd., *v.* Fiat Motors, Ltd., in which damages to the amount of £2,300 were awarded.

The action was brought to recover damages for a breach of contract made between the plaintiffs and the defendants in February, 1901, under which the defendants agreed to deliver to the plaintiffs an omnibus for £950 and six chassis at £650 each. The plaintiffs thought that their service would be greatly benefited by being fed by motor-omnibuses, and a contract was entered into. When the omnibus and the chassis were delivered it was found that they were too light for the heavy roads over which they were required to work, and, as a consequence, there were continuous breakdowns and delays in the traffic. The contention of the defendants was that the plaintiffs bought the omnibus and the chassis upon their own judgment as a specified article under a trade name, but the Judge in the Court below held that the defendants knew the purposes for which the vehicles were required, and that the plaintiffs relied upon the sellers' skill and knowledge to supply goods free from defects.

The defendants appealed on the ground that the Judge was wrong in holding that there was a warranty either expressed or implied, and that his decision was against the weight of evidence.

The appeal was dismissed with costs.

STEALING ELECTRICITY.

A CASE was heard before Mr. J. M. Yates, K.C., stipendiary magistrate, at the Manchester County Police Court on the 21st inst., against J. F. Churchard, of Second Avenue, Trafford Park, who was summoned at the instance of the Trafford Power and Light Supply, Ltd., for fraudulently using electricity between January 12th and July 12th, to the amount of 23s.

MR. W. L. HOSKIN stated that in every house where the current was used there was a meter, in which tokens, which were supplied by the company to the consumer, were placed. Each token cost 3½d., and for each one inserted a 16-C.P. light for over 16 hours was obtained.

A meter was placed on the solicitors' table, and MR. CHAS. HICKS, the company's manager, explained in detail the mechanism of the meter, showing how by the insertion of a wire the mechanism could be so manipulated that the current could be obtained without a token being inserted. The total amount of electricity used by the defendant was worth £1 3s. In answer to a question from the Bench, the manager said they kept a register of all the tokens supplied to the consumers in any block of houses in Trafford Park, and by the number of the tokens given out they could gather as to the amount of electricity that was likely to be used.

DEFENDANT admitted having inserted a wire, and was fined 20s. and costs.

NATIONAL TELEPHONE CO. *v.* MORRISON.

AT the Manchester County Court on the 21st inst., the National Telephone Co., Ltd., claimed £7 10s. 6d. rent of a telephone, from Thos. Morrison, theatre proprietor, Erskine Street, Manchester. Morrison said that part of the premises he had in Erskine Street comprised a theatre, and the other part was a disused building. The telephone had been put by the company in the disused building, where it was of no use to him.

Judgment was given for the plaintiffs for the amount claimed, with costs.

COLLINS *v.* BRADFORD CORPORATION.

AT the Leeds Assizes, on Monday, Mark Collins (46), carter, of Bradford, sued the Bradford Corporation for damages for injuries sustained in a tramway accident, negligence being alleged. Mr. A. E. M. Innes, K.C., was for the plaintiff, and Mr. W. Waugh, K.C., for the defendants.

MR. INNES stated that on September 15th last year the plaintiff was taking a cart containing bricks down Leeds Road, Bradford, when he was obliged to go on the tramlines behind another cart and in front of a tramcar coming in the same direction, owing to an obstruction. The car crashed into the rear of the cart, throwing plaintiff to the ground, and causing concussion of the brain and other serious injuries. He had suffered since from epilepsy, and had had 40 epileptic fits since the accident. Corroborative evidence was given by the plaintiff and his wife and by medical men.

The driver of the car, JOHN BREARLEY, said that, having turned the finger of the controller into the eighth notch in order to get up speed, he turned it down again, intending to shut off the current, but found the controller pointer would not move beyond the sixth notch. He rang the bell and shouted to plaintiff, but the latter took no notice, and before he could shut off the power the car dashed into the cart, turning it almost round, and afterwards smashed up a timber wagon. He had never known the controller stick like that before. The car, at the time of the collision, was going at about six miles an hour.

MR. C. J. SPENCER, manager of the Bradford Tramways, said he had never known a controller stick in this way before. It was due to fusing, but what caused it he could not say.

DR. CAMPBELL, of Bradford, who had examined the plaintiff, said he thought he would completely recover in from five to six months from the date of his examination.

The Corporation set up the defence that the finger of the controller had become electrically fused, and it was an unusual accident for which they could not be held responsible.

The jury returned a verdict for the plaintiff, and awarded £350 total damages. His LORDSHIP accordingly entered judgment for that amount.

MANCHESTER CORPORATION *v.* DIDLICK.

AT the Manchester County Court on Monday last, the Manchester Corporation applied to the Court for the termination of the weekly payments of 17s. per week to Charles Didlick, a tramway worker for the Corporation. Mr. M'Elroy, general manager of the tramways, was present. Mr. E. E. Jones, foreman of the permanent way section of the tramways department, spoke to Didlick having been 14 years employed with the Corporation at 34s. per week. He hurt his back while in the employ of the Corporation in April, 1907. He was a leading platelayer. Light work had been found for the respondent, who complained of his back, although witness believed he did not try to the best of his powers. Dr. Thorburn said he was convinced that Didlick was malingering. Respondent said the accident occurred when he was helping to load a 60-ft. tramrail on to a lorry. He was under Dr. Mackenzie for six months, and was still an out-patient of the infirmary. He was taking the electrical treatment prescribed for him by one of the physicians. Mr. M'Elroy said the Corporation would find light work for the respondent. Deputy-Judge Leresche, accepting the evidence for the Corporation, diminished the order to 5s. per week, on the understanding that the Corporation was to find light work for Didlick.

JACKSON *v.* L.C.C.

ON Monday last damages were awarded by a jury in this case, in which Edward Jackson, house decorator, sued the L.C.C. in respect of personal injuries. Evidence was given to the effect that the plaintiff was travelling in a tramcar, and as it came to a standstill he rose to his feet, when a second car collided with the one he was in, and he was thrown down violently. He was rendered unconscious by the shock, and had been in the hands of medical men ever since. The defendants called no witnesses, and the damages were assessed by the jury at £415.

PARLIAMENTARY.

Railway Companies and Electric Mains.

DURING the proceedings in connection with the consideration of the Electric Lighting Provisional Order (No. 2) Bill before a Select Committee of the House of Lords, presided over by Lord Clinton last week, an important question was raised as to who should bear the cost of altering and removing mains and pipes of electric lighting companies which passed over railway bridges.

MR. MACASSEY, who appeared for the promoters, explained that under the Order, powers were given to transfer the Ardrossan and Saltcoats Electric Lighting Order to Mr. George Balfour, of London. The actual proposal was not opposed, but the Caledonian Railway Co. were asking for the insertion of a clause whereby the owners of the electric mains and pipes which crossed their railway bridges should bear the cost of any altering or removal of such lines in the event of the bridges being widened or reconstructed. Counsel said there was no precedent for this, and to insert such a clause would be reversing the whole practice of Parliament. The railway companies had for many years been endeavouring to get similar clauses in electric Bills, but without success. The railway companies appeared before the Select Committee in 1882, when the Electric Lighting Acts of that year were thoroughly considered, and asked for this protection, but after hearing all the evidence, the Committee rejected the proposal. The Board of Trade were so strongly opposed to these railway protective clauses, that they refused to insert them, even in the case when the parties were agreed. Parliament had, however, in recent years inserted clauses for the protection of county councils. He would point out that this question, even in the case of county councils, had not been contested, for the clauses were agreed between the parties.

Questioned by the CHAIRMAN as to the distinction to be drawn between bridges owned by a County Council and by a railway company, COUNSEL said that the first party constructed bridges to get over natural obstacles, but railway companies made them to suit their own purpose. If a railway company reconstructed or widened a bridge it was because the situation or growth of the traffic demanded it.

Proceeding, MR. MACASSEY referred to the Electric Lighting (Amendments) Act, 1909, and said that although the House of Lords inserted a similar clause to that which the railway companies were asking for, that clause was struck out by the House of Commons.

MR. FITZGERALD, K.C., arguing for the Caledonian Railway Co., said that an electric company did not cross a bridge by invitation, and, therefore, railway companies did not see why they should pay for the removal or altering of mains and pipes of persons who happened to run across their bridges. Similar clauses to that which he was putting forward had been inserted in water and gas Bills, and he asked that it should be included in the Bill under consideration.

Similar arguments were put forward in the case of the Cambuslang Extension Order, which provided for the extending of the limits of supply. The Lanarkshire County Council, who were the owners of the Order, had to cross over a bridge of the Caledonian Railway, and the latter party asked for a clause similar to that which they put in, in the previous case.

The Committee decided to confirm the Orders, but would not give the railway company the protection they asked for.

London United Tramways.

ON Thursday last week the Bill promoted by the London United Tramways Co. came before the Select Committee of the House of Commons, of which Mr. Emmott is chairman.

MR. H. CRIPPS, Parliamentary agent for the promoters, explained that it was a Bill to extend the time for the electrification of a short piece of tramway in Richmond. The line was authorised to be constructed on the electric system of traction in 1902, but various difficulties had prevented the carrying-out of this. One of the principal difficulties had been a controversy with the Richmond Corporation as to what system the line should be worked on. The Bill said that a system other than the "overhead" was to be used. The promoters, however, considered that to lay the surface contact or conduit system down was too expensive, and they had come to an arrangement, whereby the overhead system could be used by agreement between the Richmond Corporation and the company.

MR. G. H. STANLEY, general manager, proved the preamble, and stated that they originally asked for the period for completing the work to be five years, but that had now been reduced to one. There was a clause in the Bill which prevented the erection of standards in the centre of the road without the permission of the police.

The Bill was ordered to proceed.

London County Council Tramways.

THE Bill promoted by the London County Council, which provides for the reconstruction and electrification of certain parts of the Council's tramway system, came before a Select Committee of the House of Lords, with Lord Clinton in the chair, last week. The measure has already passed the House of Commons.

MR. ERSKINE POLLOCK, K.C., in opening the case for the promoters, said that there were only four opponents to the proposals contained in the Bill. The L.C.C. had a system extending over 144 miles, of which 113 were worked by electric traction. The tramways carried 451½ million passengers last year, as compared with 164 millions five years ago. The Council employed 10,000 persons in connection with the tramways, and had 1,250 electric cars. The first part of the Bill that was opposed was the proposal to make a connection between the Brixton and Norwood systems. The line would be on the overhead system, and would cost £24,000. The opponents to this part of the Bill were the Lambeth Borough Council.

Evidence was then given in support of the County Council's case.

MR. C. MUNRO, speaking on behalf of the Lambeth Borough Council, said that the proposal of the County Council to construct the tramway at Brockwell Park only 2 ft. 6 in. away from the pavement was contrary to the whole policy of Parliament. It had been laid down in the 1870 Tramways Act that there should be 9 ft. 6 in. of roadway on either side of a tramway track. He asked that the County Council should set back the park railings so that the footpath could be altered, and thus allow a 9 ft. 6 in. roadway on either side of the track.

MR. MUNRO called a number of witnesses, who spoke in opposition to the proposal to construct the tramway in the Dulwich Road by Brockwell Park only 2 ft. 6 in. away from the kerb.

MR. S. SELLON, consulting engineer, speaking from personal knowledge, said that he considered the proposal was not a practical one. He had always held that a double line of tramways should not be constructed in a roadway less than 50 ft. in width. The Dulwich Road was only 25 ft. in width. As to the offer of the County Council to make only a single line, he contended that it could not be worked efficiently, as there would be a congestion where the line passed into a double one.

Cross-examined: WITNESS said that he remembered reporting to the Traffic Commission that there were many instances of streets being less than 50 ft. in width. He added, however, that in the cases referred to there was no heavy vehicular traffic, such as there was in London streets.

As this stage of the proceedings, the CHAIRMAN intimated that the Committee were satisfied, on the evidence before them, that a case had been made out for the widening of Dulwich Road. They thought, in view of the allegation by the Lambeth Borough Council as to the traffic passing along the road, that that authority should pay something towards the cost of the widening.

The proposal to construct an extension of the Tooley Street tramways 250 ft. towards London Bridge was then considered by the Committee.

It was stated in evidence that the Council felt that this was an important scheme, although only a short line was proposed. The tramway would be, in one part, a single track.

The scheme was opposed by the owners and lessees of wharves and property along the proposed route.

Evidence having been given in support of the Council's case, including that of MR. A. L. C. FELL, tramways manager, who said that he estimated they would get a revenue of £143 per year on the extension,

WITNESSES were called on behalf of the Proprietors of Hay's Wharves, who contended that the proposed tramways would seriously hamper the company's business.

MR. J. HUMPHREYS, one of the Proprietors of Hay's Wharves, in cross-examination by Mr. POLLOCK, would not admit that it was a case of his firm against the convenience of the travelling public.

SIR A. R. STENNING, an ex-President of the Surveyors' Institute, said that, in his opinion, to lay down a double line of tramways down Tooley Street would be very dangerous, having regard to the heavy traffic and the narrow thoroughfare.

MR. R. E. COOPER, consulting engineer, gave similar evidence.

The Committee adjourned, and on the resumption of the sitting,

The CHAIRMAN said that the Committee had paid a visit to Tooley Street since the previous day's proceedings, and had inspected the place where it was proposed to extend the tramway. The Committee had come to the decision not to allow the powers asked for. They realised the advantages of through traffic, but, at the same time, they thought the views of the traders in the thoroughfare should be considered, and so long as the circumstances remained unchanged, the Committee did not think it right to pass the proposal.

Evidence was then given as to the powers the Council asked for in regard to the erection of shelters or waiting rooms. It is proposed to have these conveniences at Stamford Hill, New Cross, and at the eastern end of the Embankment. In the latter case, the proposal was opposed by the City Corporation, who contended that they should have the power of saying whether the shelter hereafter erected should be removed in order to properly regulate the traffic. The Corporation were not opposed to the erection of the shelter, but acted solely on the question of future control. They were not hostile to the proposal.

The County Council, on the other hand, argued that the removal of the shelter should only be possible by the consent of both parties. The Council were already spending an extra sum of £600 on the construction of the shelter in order to meet the various suggestions of the Corporation. The cost of the structure would be £1,800. The shelter at New Cross would have a glass roof, with pillars, and open-sided, and this, and the one at Stamford Hill, would cost between £200 and £300 each.

The Committee decided that the City Corporation should not interfere with the structure for 10 years.

After hearing police evidence to the effect that the Commissioner considered it undesirable that permanent structures should be erected, the Committee allowed the Council the powers, and the Bill was ordered to proceed.

On Monday the London Electric Supply Bill was read a first time in the House of Lords, and the Mines Accidents (Rescue and Aid) Bill a second time.

On Tuesday the London United Tramways Bill was read a third time.

BUSINESS NOTES.

Willans Condensing Plant Contracts.—Amongst the recent orders for surface condensing plants received by MESSRS. WILLANS & ROBINSON, LTD., are the following:—

1	set for dealing with	100,000 lb.	steam P.H.,	for the East Rand Mines.
2	" "	64,000	" "	Sydney Corporation.
2	" "	41,000	" "	Australia.
1	" "	36,000	" "	Cardiff Corporation.
3	" "	34,000	" "	Canada.
1	" "	30,000	" "	Eastbourne Corporation.
1	" "	30,000	" "	South Africa.
1	" "	28,000	" "	Belfast Corporation.
2	" "	22,000	" "	Devonport Dockyard.
2	" "	21,000	" "	Midland Railway, Derby.
2	" "	20,000	" "	Pleasley Colliery.
2	" "	17,000	" "	Baldwins, South Wales.
1	" "	15,000	" "	Calcutta Elec. Supply Co.
1	" "	13,000	" "	Carlisle Corporation.
2	" "	7,500	" "	Swansea Harbour Trust.

Sectional Superheaters.—MESSRS. JAMES GORDON AND CO., 81, Knightrider Street, London, E.C., are placing on the market a new patented sectional superheater, for which many advantages over existing designs are claimed.

Mercury Vapour Lamps.—Referring to the article by Mr. Crouch, concluded in our last issue, the WESTINGHOUSE-COOPER-HEWITT CO., LTD., inform us that the current prices of their mercury vapour lamps are 20 per cent. lower than those on which Mr. Crouch based his calculations, so that the economic advantages of the Cooper-Hewitt lamps are to that extent better than he showed. The company state that they are also manufacturers of a patented quartz mercury vapour lamp, similar to the Heraeus lamp referred to in the article, having a guaranteed minimum life of 1,000 hours, and giving a bluish-white light. Further particulars of this will be awaited with interest.

Electric Railway Exhibition.—The International Exhibition of Electric Traction on Railways at St. Petersburg will be opened on April 15th, 1911.

Bankruptcy Proceedings.—JOHN ARTHUR FREDERICK MILTON, electrician, 258, Hungerford Road, late 18, High Street, Crewe, Chester.—This debtor attended at the Petty Sessional Court House, Edleston Road, Crewe, on July 22nd, for his public examination before Mr. Registrar Speakman. In reply to the Official Receiver, the debtor said that until his father's death he was a partner in the firm of Henry Milton & Son, plumbers and painters, of High Street, Crewe. The total liabilities of the firm were £340 16s. 2d., and the assets were of the estimated value of £203 3s. 9d. His own separate estate showed liabilities £59 11s., and the assets were of the estimated value of £29 10s. 5d. Proper books of account were not kept by the firm. The largest trade debt was £124, due to Messrs. Greatorex Bros., Ltd., of Manchester, for goods supplied between October, 1909, and January, 1910. A debt of £26 was due to Messrs. Williams & Watson, of Liverpool, for glass supplied to the firm in 1907. The firm's book debts were very considerable. Bad and doubtful book debts amounting to £506 16s. 7d. were estimated to produce £79 14s. 9d. Good book debts were of the value of £71 13s. 2d. Debtor had also carried on the business of an electrician for 11 years. He had no capital when he started. He sold the stock he had in that department about April last to pay his own debts. Debtor attributed his failure to want of capital, and keen competition. He had drawn £2 weekly from the business for household and personal expenses. The examination was formally adjourned.

ERNEST ALBERT THORN, 34, Cedars Road, Clapham Common, and carrying on business at 22, Mossbury Road, Clapham Junction, London, S.W., electrical engineer.—The first meeting of the creditors of the above was held last week, at the offices of the Official Receiver, 132, York Road, Westminster Bridge, S.E. Mr. H. Ll. Howell (the Official Receiver) presided. No resolutions were passed, and the matter, therefore, remains in the hands of the Official Receiver. It appears that the debtor was brought up to be a plasterer and worked as a journeyman up to about three years ago. In November, 1907, he was out of employment, and he then commenced to do jobbing work for different people. Towards the end of 1908 he began to contract with builders to do work on buildings in course of erection, and he had done that kind of work ever since. He had never done any work for the general public, but had about six men in employment. Last February two creditors commenced proceedings against him, and he then consulted his solicitors. On April 2nd a meeting of his creditors was held, but in order to protect the estate in the meantime a deed of assignment was executed. The trustee under the deed had taken possession of the assets, and was still carrying on the business. The debtor had been employed by the trustee at a salary of £2 10s. a week. At the meeting of his creditors the debtor made an offer of a composition of 6s. in the £, payable by three quarterly instalments. This offer was not accepted, and the petition in bankruptcy was afterwards presented, on which the receiving order was made. The debtor attributed his failure to "losses on contracts," and estimated his liabilities at about £200.

ALFRED JAMES HOLLINGTON, electrical engineer, late of 37, Walbrook, E.C.—An application for an order of discharge was made on Thursday last week to Mr. Registrar Hope, at the London Bankruptcy Court. The Official Receiver reported that the applicant failed in 1904, with provable debts £347 and no realisable assets. He was taken into partnership in June, 1896, by his employer, who carried on a wholesale electrical stores at Bush Lane, E.C. The bankrupt introduced a capital of £1,000, and on his retirement from the firm he was refunded £900, which he invested in an electrical engineering company. The latter concern failed in December, 1900, and the bankrupt lost his money. Three months later he commenced business at 37, Walbrook, as an electrical engineers' supply stores, and in the following December he purchased for £130 the stock and effects of a similar business carried on in the same building. He continued there until December, 1903, when, being in financial difficulties, he ceased trading, and subsequently realising his remaining stock, effects and book debts, he applied the proceeds in payment of debts and expenses. The failure was attributed to bad debts and bad trade. The only offence alleged was the insufficiency of assets to pay 10s. in the £ to the creditors. The order granted a discharge subject to a judgment for £25, to be paid within a month. Order entered accordingly.

South African Trade.—The returns published by the Customs Statistical Bureau for the first five months of the present year show that the imports have increased in value by over £4,000,000 and the exports by over £3,500,000. Amongst the most important increases in imports are electrical fittings, £122,000 more than last year, and machinery of all kinds, especially electrical, £192,000. Amongst the exports copper ore and regulus show an increase of £97,000.

Engineering Exhibition.—The Right Hon. Sir George Reid, High Commissioner for the Commonwealth of Australia, has promised to open the Engineering and Machinery Exhibition, Manchester, next October.

Advance in Prices.—MESSRS. ARTHUR CORT & CO., Bullace Works, 303½, Camberwell Road, S.E., announce an advance of 20 per cent. (dating from July 1st) in prices of gutta-percha and Chatterton compound.

First Meeting.—HAROLD BRISTOW, plumber and electrician, Kingston-upon-Hull.—The first meeting will be held on August 4th at the Official Receiver's Offices, Hull, and the public examination on August 15th, at Hull.

Holidays.—THE "OMEGA" ELECTRIC LAMP CO., LTD., of Palace Works, Crab Tree Lane, Hammersmith, W.—The factory will be closed for a holiday from Monday, August 1st, to Saturday, August 6th, both days inclusive.

MESSRS. W. H. ALLEN, SON & CO., LTD., Queen's Engineering Works, Bedford.—The works will be closed from Saturday, July 30th, until 9 a.m. on Monday, August 8th.

MESSRS. A. SEAGE & CO., London, W.—The works and offices will be closed from noon, Saturday, July 30th, until Monday, August 8th, 1910.

THE BRITISH PROMETHEUS CO., LTD., Salop Street Works, Birmingham.—The works and offices were closed on Wednesday, July 27th, and will be re-opened on Monday, August 8th, 1910.

THE WESTERN ELECTRIC CO., LTD., North Woolwich, E.—The works will be closed from Monday, August 1st, to Saturday, August 6th, inclusive.

THE ADAMS MANUFACTURING CO., LTD., Bedford.—The works will be closed from Saturday, July 30th, until 8.45 a.m. on Monday, August 8th, 1910.

MESSRS. WILLANS & ROBINSON, LTD., Victoria Works, Rugby.—The works and offices will be closed for the week from Friday, July 29th, to Monday, August 8th, 1910.

No goods must be sent to arrive at the above-named works between the dates named, unless specially requested.

Underfeed Stokers.—Amongst orders recently placed for some 67 of these stokers, we note that the local authorities of Erith and Tunbridge Wells have purchased four and two respectively of the B5 type.

Japan-British Award.—The Grand Prize has been awarded to the REES-ROTURBO MANUFACTURING CO., LTD., for their well-known pumps.

Catalogues and Lists.—LONDON INDIA-RUBBER WORKS, Hackney Wick, N.E.—Samples of "Para" and "Pure Rubber" tape for electrical purposes.

MESSRS. ARCHIBALD J. WRIGHT, LTD., Leyton Green Road, London, N.E.—As the firm are removing in September to larger and more convenient premises in the City, they have issued a "removal sale list" giving special prices of a variety of small electrical goods.

MESSRS. HANS RENOLD, LTD., Progress Works, Brook Street, Manchester.—New catalogue 5/26 of their patent silent chains and sprockets, with full particulars as to their dimensions, prices and applications, which are very numerous and varied. The instructions as to choosing and laying out silent chain gear have been extended in accordance with experience. Certificates of registration have recently been granted to the firm for the use of the name "Renold" and a corresponding trade mark.

THE SUN ELECTRICAL CO., LTD., 118 and 120, Charing Cross Road, W.C.—Catalogue of electrical accessories, Section X, Part I, covering lampholders, candle fittings, ceiling roses, cut-outs, adapters, staples and clips, wall plugs, couplings, tumbler switches, insulating and erecting materials, &c., in great variety. Part II will deal with distribution and switch boards, main switches, &c.

MESSRS. WAILES, DOVE & CO., LTD., Newcastle-on-Tyne.—Pamphlet relating to their patent "Bitumastic" solution and enamels, as used for pipe lines, steel chimneys, water tanks and exposed ironwork generally.

MESSRS. BURROUGHS, WELLCOME & CO. send us a neat little guide to their exhibits at the Japan-British Exhibition, which, besides their well-known pharmaceutical specialities, include photographic materials.

THE CAMBRIDGE SCIENTIFIC INSTRUMENT CO., LTD., Cambridge.—Price list No. 58, of Duddell patent oscillographs. The remarkable popularity of this instrument, and the wide and increasing range of its applications, are well shown in this interesting pamphlet, which is much more than a mere catalogue, being rather a technical treatise on the construction and handling of the oscillograph. Since the issue of the list, we understand, two orders have been received from Japan and Austria for complete sets of the apparatus for use on 50,000-volt circuits.

MESSRS. WRIGHT & WOOD, LTD., Century Works, Halifax.—List No. 30, illustrating their D.C. motor-generators, from 240 watts to 25 KW., single-field rotary transformers from 90 to 5,750 watts, rotary converters and induction motor-generators, with full prices, shipping particulars and other data.

MESSRS. EASIMAN & WARNE, Aston Vale, London, W.—Leaflet describing their electric heaters of the convector type, with prices, and the advantages of electric heating in dwelling rooms.

MR. G. BRAULIK, 8, Lambeth Hill, E.C.—Pamphlet No. 3, giving particulars of the "Beez" and other types of pocket volt and amperemeters, battery testers and inspection lamps, and accumulators in celluloid for ignition and similar purposes.

MR. OTTO BILAND, St. Imier, Switzerland.—Catalogue of revolution counters with and without chronographs, covering a wide range of practical requirements, and chronoscopes and chronographs for accurate measurements of time.

Dissolution.—G. HARLAND BOWDEN & CO., Manchester.—The business carried on by Messrs. George Harland Bowden, Frederick Carleton Anderson and Charles Atherton Atchley, under the firm name of "G. Harland Bowden & Co.," has been dissolved. Mr. Harland Bowden will continue the London and South Wales branch of the late firm at Suffolk House, 5, Laurence Pountney Hill, London, E.C. Mr. Anderson and Mr. Atchley will continue the Manchester and Glasgow branches in partnership at 196, Deansgate, Manchester, and 50, Wellington Street, Glasgow, as heretofore under the firm name of "The Harland Engineering Co."

Trade Announcements.—MR. TH. SERVANIS has opened an establishment at 23, Rue Mertébany, Galata, Constantinople, for the sale of material and apparatus for electrical installations, wholesale and retail. No doubt he would be pleased to receive price lists of British manufacturers.

MESSRS. SPEEDY, EYNON & CO., of 3, Adelaide Street, Charing Cross, W.C., have given notice of their removal to 6, Duke Street, Adelphi, Charing Cross. Telephone number as before.

THE BRITISH WESTINGHOUSE ELECTRIC AND MANUFACTURING CO., LTD., of Birmingham, have removed from Winchester House, Victoria Square, to Avebury House, 55, Newhall Street, Birmingham.

LIGHTING and POWER NOTES.

Alloa.—The Corporation having taken over the manufacture and distribution of electricity from the British Electric Plant Co., is erecting a power station at the gas works, where a complete equipment of generating plant will be installed.

Arva (County Cavan).—A local committee, of which Mr. D. Hearton has been appointed the secretary *pro tem.*, has just been formed in this town for the purpose of taking into consideration a scheme for the electric lighting of the town.

Aston Manor.—A L.G.B. inquiry was held on Friday last into the application of the T.C. for a loan of £23,105, £12,515 being for plant and machinery, and £10,590 for mains and services. Mr. H. R. Hooper, the Inspector, criticised the action of the Council in transferring £1,500 of the profits to the reduction of the rates and borrowing a similar sum at 3¾ per cent. for extensions of services. At his suggestion it was agreed to include the £1,500 under mains, and that in future the cost of services should be met out of revenue.

Australia.—The 1909 report on the Sydney (N.S.W.) city electrical undertaking, to hand, contains many interesting details, showing the rapid extension of electricity supply in the city. The units sold during the year amounted to 11,914,720, an increase over the previous year's output of 3,240,778. The maximum load was 6,040 KW., and the load factor 17·11 per cent. For private lighting approximately 5,300,000 units were sold, or an average of 46 units per 16 C.P. equivalent connected; power purposes absorbed 5,141,926 units, the motors supplied comprising some 10,978 H.P., an increase during the year of 2,688 H.P., and including 725 hired motors of 2,611 H.P. (1,496 D.C. H.P. and 1,115 A.C. H.P.). The rate of increase of hired motors is apparently falling, but the opposite is the case with arc lamps, of which 1,012 (including 827 enclosed type lamps) are on hire. The average total cost per unit, including financial charges, depreciation, &c., was 1·99d., and this included ·585d. per unit for generation and ·343d. per unit for distribution and management. Fuel cost ·27d. per unit. The revenue from all sources averaged 2·24d. per unit sold; private lighting gave 3·04d.; power and heating, 1·37d.; and public lighting, 1·13d. During 1909 a storage battery was installed, and Mr. Forbes Mackay, the city electrical engineer, points out that during the year, with an increase in output of 37 per cent., the cost of production has fallen nearly 10 per cent., largely owing to the use of the battery. Eight H.T. cables were laid across Darling Harbour. Tenders were accepted for two 4,000-KW. turbo-generator sets, five 24,000-lb. capacity boilers, 3,200 KW. of motor-generators and the necessary sub-station switchgear; this plant is expected to be in use by the end of this year. Evidently the year was a most satisfactory one, on which we may well congratulate the engineer, Mr. Forbes Mackay. With certain of his concluding remarks on the subject of depreciation we cannot agree—in fact, Mr. Mackay appears to be quite misinformed as regards British practice in matters of depreciating assets—and the subject being of more than passing interest, we have referred to it in our leading columns in this issue.

The Launceston (Tas.) Council is proposing to invite alternative tenders for a 500-KW. high-speed engine or turbine and alternator.

Barnstaple.—The T.C. has decided that further expenditure on account of advertising the advantages of electricity or exhibitions is undesirable until satisfactory arrangements have been made for the proper display and supply of fittings, and further facilities afforded for wiring the premises of prospective consumers.

Blackburn.—Due to a cable fault, only an intermittent supply of electricity could be given to a portion of Blackburn on July 21st. As a rule little trouble is experienced in locating the source of failure, but in this instance the greatest difficulty was experienced owing to the unusual nature of the fault. A considerable time elapsed before the trouble was overcome.

Bury.—The Electricity Committee has instructed the engineer to substitute metallic-filament lamps for the existing arc lamps in Stanley Street and Water Street.

Camborne.—The Urban Electric Supply Co. has informed the U.D.C. that it is applying to the B. of T. authorising it to give a supply of current to Dolcoath Mine. The Council has consented to the application.

Canada.—Mr. A. A. Dion, superintendent of the Ottawa Electric Co., has been selected as referee in the big dispute between the Montreal Light, Heat and Power Co. and the City of Montreal, regarding the lighting of the city. The contract between the city and the company expired some years ago, but in the absence of any definite rearrangement the company went on supplying light at the old figures. The city now disputes the bill. Prof. Herdt, of McGill University, is the representative of the city in the dispute, and Mr. Black, the well-known Toronto expert, appears for the company.

Canterbury.—The B. of G. has appointed a Committee to consider the advisability of lighting the workhouse by electricity. At present gas is used, at a cost of about £200 a year, and it is contended that electricity would cost less. The capital cost of wiring, &c., is placed at £93.

Cirencester.—Mr. James H. Edmonds, of Victoria Street, Bristol, has informed the R.D.C. that he intends applying for a prov. order for E.L. in the area of the Council.

Continental Notes.—SWEDEN.—The power station and plant of the Torsebro waterfalls on the Helge River has been completed, the work having occupied nearly two years. The power derived from the falls amounts to 3,000 H.P., which is distributed by the Hemsjö Co. among various customers, all in some way connected with the company. The water is conducted through a tunnel for a distance of 350 metres.

The electrical plant at the Stenkvill-Klinte waterfalls on the Emons River, flowing from the Lakes Mömmen and Solgen, has also been finished. The work was commenced in 1907, with the object of transmitting electrical energy to manufactories in the neighbourhood, and the total cost amounts to £41,700. The output is about 2,000 H.P., of which half is already disposed of. The tunnel by which the water is conducted to the concrete penstock is 375 metres in length.

FRANCE.—A report from Zurich announces that the Franco-Swiss Electricity Co., of Geneva, in conjunction with large French banking institutions, is interested in a scheme for the utilisation of the water power of the Rhone for industrial purposes and the transmission of power to Paris.

BELGIUM.—A new company has just been formed in Tournai with a capital of £60,000, and the title, La Société d'Eclairage, Chauffage et Force Motrice de Tournai et Extensions, to supply gas and electrical energy for lighting and power purposes in the town and district named.

HOLLAND.—The Amsterdam municipality proposes to extend the plant at its electricity works. The Daventer Municipal Council has decided to establish an electric power station for the towns of Daventer and Zevolle.

TURKEY.—Belgian Consular advices state that the town authorities of Tripoli are examining the question of the construction of an electric generating station for lighting purposes, electric tramways, telephone system, &c.—*Board of Trade Journal.*

Coventry.—The City Council has resolved to support the I.M.E.A. proposals for giving power to local authorities to supply fittings and wires on consumers' premises, and dealing also with the question of stand-by supply and supply by unauthorised undertakers.

Croydon.—At the B.C. meeting on Monday it was reported that the new Home Office regulations regarding electric supply would necessitate an expenditure of £1,176 at the electricity works. On the recommendation of the Committee concerned, the Council decided on meeting the most pressing requirements first, at an estimated expense of £515, to be charged to the revenue account.

Derby.—The T.C. has decided to extend the direct-current supply to the works of Messrs. Cox Bros. & Co., Normanton Road, at a cost of £400. The firm guarantees payment of £200 for energy during the first year, £300 the second year, and £300 the third year.

Dublin.—The L.G.B. has sanctioned the expenditure by the Poor Law Guardians of the South Dublin Union of the sum of £3,000 on the electric lighting of that institution. The scheme had been on hand for a considerable time.

Dundalk.—An inquiry has been held by Mr. A. W. Trotter, electrical adviser to the B. of T., into a scheme of electric lighting in the town. It is proposed to have 9 miles of overhead wires and underground cables in the main streets.

Edinburgh.—The balance of revenue for appropriation in the Corporation Electricity Department at the close of the financial year, which had been estimated at £2,020, has turned out to be £8,263. The Electric Lighting Committee considered a motion by Mr. Stevenson as to the disposal of the surplus, but it was agreed to delay consideration of the matter until the Committee had a report from their engineers as to whether they had any suggestions to make in regard to the undertaking. The Committee also considered a motion as to the price of current for 1910-11, and it was agreed to recommend that there be no change. An amendment that the price for motor power be reduced by one-eighth of a penny was defeated.

Falmouth.—The T.C. has decided to take into consideration the advisability of exercising the powers to purchase the undertaking of the E.L. Corporation.

Haslingden.—At the Council meeting on July 21st, it was reported that terms had been received from Accrington and Rawtenstall Corporations, and Lancashire Electric Power Co., for a supply of electricity for Haslingden. A Sub-Committee was appointed to seek an interview with the Accrington Committee respecting the terms offered by it. The Council decided to take no action in regard to the memorial from the Haslingden Trades' Council "deeming it expedient, in the interest of the ratepayers, and the town generally, that the work of generating electricity both for light and power purposes should be commenced at once."

High Wycombe.—The electric light company has informed the T.C. that it intends applying for an order extending the area of supply to those portions of the borough added in 1901.

Hyde.—The T.C. has been recommended to have the hospital lighted by electricity.

Launceston.—The B. of T. has informed the T.C. that it proposes to revoke the E.L. order granted in 1903, but before doing so would be glad to learn whether the Council had any observation to offer. A letter from the Electric Supply Corporation, Ltd., stated that the company found it impossible to proceed with the order. The Council has decided to ask the B. of T. not to revoke the order, as Mr. J. A. Purves, of Exeter, was prepared to carry out a scheme on the lines of that at Paignton.

Limehurst.—The Oldham T.C. has applied to the U.D.C. for consent to supply current to premises in its area. The Lancashire Electric Power Co. has already given sanction to the T.C. supplying consumers in the district, and the U.D.C., before coming to any decision, has asked the T.C. how many consumers were to be supplied, and the system to be adopted.

London. — HACKNEY. — The Electricity Committee has had under consideration the problem of extending the distributing system so as to relieve the existing feeders of the overloading to which they were subjected last winter; the total estimated cost of the proposed extensions is £18,384, and extensions of switchboard and connections will cost another £900. The cables will be purchased under a current contract with the British Insulated and Helsby Cables, Ltd., but tenders are to be invited for the switchboard. The Committee go on to say that there is now so much practical heating and cooking apparatus on the market, that it is well worth while to cater strenuously for the domestic heating and cooking business. In order to stimulate this branch of the business the Committee has decided in favour of the tariff being modified from September 1st next, so that all supplies for domestic purposes other than lighting shall be given at 1d. per unit. In connection with the foregoing, the Committee is to introduce the modified maximum demand system, such as has been tried at Marylebone and Hampstead, with great success, and which is known as the "telephone" system. Under this the following optional rate for the supply of energy for lighting and for other domestic purposes in premises which are lit solely by electricity is to be adopted: A rent at the rate of £2 per KW., which is equal to using electricity at the rate of 1 unit per hour, and would give an illumination of 800 C.P. from metal-filament lamps equal to 25 32-C.P. lamps per quarter, based on the rate at which the consumer desires to use the supply, payable quarterly in advance, and a charge for electrical energy used each quarter of 1d. per unit, with a discount at the rate of 10 per cent. of the rent to consumers who pay four quarters' rent in advance. The showroom and offices in Mare Street, are to be fitted up at an estimated cost of £550.

FULHAM.—The E.L. Committee proposes to use hour meters and a fixed charge of 3½d. per unit, using an 8-C.P. carbon lamp, for the one or two lights required in the halls and staircases of maisonettes.

Loughborough.—At a meeting of the T.C. on Monday, Ald. Bumpus, chairman of the Gas and Electricity Committee, referring to the judgment in the Leicester case, said that in their local Act they had ample powers for all they had done, and more than they had done, by supplying electric motors, &c., so that they were not acting in any way beyond their powers.

Lydney (Glos.).—Messrs. Morgan & Co., of Chepstow, have informed the R.D.C. that they are applying to the B. of T. for an order authorising them to supply electricity at Tutshill, Tidenham, by means of overhead cables. The Council has decided to communicate with the Gloucestershire E.L. Co., which has already obtained these powers, on the matter.

Maidstone.—The T.C. has applied for a loan of £4,000 for mains extensions.

Manchester.—The officials of the Gas and Electricity Departments of the Corporation have presented to a joint committee a report upon the basis on which the two undertakings should contribute to the relief of the rates. They recommend that the outstanding debt on each department shall be the basis on which the amount should be allocated for rate-aid purposes. According to this mode of reckoning, the Electricity Department should contribute more than the Gas Department, because its debt is higher. The Gas Department's debt is £1,212,685, while that of the Electricity Department is £1,970,112.

Nelson.—At Brierfield (Burnley) District Council meeting, on July 21st, it was agreed to enter into an agreement with Nelson Corporation for the supply of electricity on the following terms: 2½d. per unit for lighting purposes, and 1½d. per unit for power, to extend over three years.

Newmill (Yorks.).—The Holmforth U.D.C. has invited the U.D.C. and other public bodies in the district to combine with it and others in taking electricity in bulk for lighting purposes from the Yorkshire Electric Power Co.

Norwich.—The report of the Electricity Committee, submitted to the T.C. last week, remarks that the outstanding feature of the year's working was that while the output remained practically the same as the year before, such a marked reduction occurred in working expenses, that the balance was a record one. The stationary output was attributed to a temporary decline in power supply. The output for lighting was 2,008,167 units; for public lighting, 42,598 units; and for power, 2,082,432 units. The income increased by £443; working expenses were reduced from £19,070 to £16,523, and the gross profit amounted to £21,109. After meeting financial charges, the balance (carried to the appropriation account) amounted to £5,962, as against £2,286 in the previous year. With certain other items the appropriation account amounted to £6,088; £2,000 of this was added to the depreciation fund (which totals £18,005); £1,500 was contributed towards depreciation of accumulators, and a balance of £3,728 was left in the appropriation fund, which will be available for carrying out, among other things, a public lighting scheme now being prepared. The report was adopted, after a discussion which apparently arose from some suggestion for diverting certain money in relief of the rates. We congratulate the engineer, Mr. Long, and his Committee on this satisfactory result.

Paisley.—In submitting the budget for the ensuing year to the Town Council, the treasurer intimated that the accounts of the electricity department again showed a serious deficit. The estimates handed in showed a probable deficit of £73; instead of this, there is a deficiency of £1,161. This has been mainly due to over-estimation of the receipts for the sale of current. It was pointed out that the management had saved fully £480 on generation, distribution, and upkeep of public lamps, as compared with the previous year. The deficit this year has been taken from the reserve fund, and there still remains £2,051.

Penzance.—The T.C. has been informed that the Electric Supply Co. has made arrangements for a bulk supply of current from the Cornwall Electric Supply Co.'s new power station at Hayle, and this would be available by December 31st, 1911. Under these circumstances, the T.C. has decided to ask the B. of T. to defer the question of revoking the prov. order.

Perth.—In the Corporation electricity department the revenue for the past year totalled £7,935, and the expenditure £4,950, leaving a net balance of £2,985. The net revenue account shows a credit balance of £67. The quantity of electricity generated during the year was 1,021,935 units. Of this the public lamps consumed 155,898 units, the tramway department 309,019 units, and private consumers, using meters, 449,042. The total electricity sold was 913,959 units, against 932,365 last year.

Plymouth.—The statement of the electrical engineer on the working of the undertaking for the quarter ended June 30th shows a sale of 531,789 units, producing estimated receipts of £5,158, compared with 504,497 units sold and £4,910 received in the corresponding period of last year, an increase of current to the tramway during the quarter amounts to £2,018, as against £2,196, and miscellaneous receipts are £31 less than in the June quarter of last year. At the end of June the number of consumers was 1,173, as against 1,031, and the lamp connections 88,489, compared with 80,478 last year.

Redcar.—With reference to the application of Messrs. W. T. Walton & Son, of West Hartlepool, to the B. of T. for the revocation of the E.L. order sold by the U.D.C. some years ago, for £245, to the Cleveland and South Durham Power Co., the latter has informed the B. of T. that, if it could be assured that there was a reasonable prospect of electricity being generally used for lighting, it would be prepared to arrange for the extension of its cables to Redcar in the near future. In any event, it was trying to arrange a scheme of development so that the supply might be available at Redcar within the next two years. The U.D.C. on Friday decided to take no action in the matter, but to leave the question to be fought out by the two companies themselves.

Scottish Paper Mills.—Paper mills in Scotland are paying much attention to electric power installations. The Dalmore Mills, Midlothian, are at present having a 300-KW. generator and a complete motor equipment put in by the British Electric Plant Co., Ltd., Alloa. The Fettykill Mill, Leslie, have also had machinery supplied by the Alloa Co.

South Africa.—TRANSVAAL.—The results of the tramway and lighting departments of the Johannesburg Municipality for the past year show a big surplus over the estimated amounts. The estimated profit of the lighting department was £82,834, whilst the sum received will be approximately £88,577. The result of the tramway working also shows a considerable improvement, the estimated profit being £46,521, whereas the actual profit will be approximately £55,227. The total route mileage at present open for traffic is 30 miles, and there is at present under construction further tramway extensions of 7 miles. The passengers carried last year were approximately 21,498,500, as against 18,670,897 for the previous year. The average receipts per car-mile were 2s. 8·49d., against 2s. 6·64d. for the previous year.

It is reported that Mr. Howard Pim has obtained, on behalf of the Transvaal Hydraulic Power Syndicate, a licence for the installation and working of an electric generating station at Tweefontein, district of Middelburg. The station is to use small and second class coal from the Tweefontein colliery, and is to obtain its water from storage reservoirs on the Olifants River and the Zaaiwater and Piet Spruits, whence it will be brought to the station by means of pipe lines. It is proposed to form a company, with a nominal capital of £926,000, to take over the undertaking.

The Government has accepted the tenders of Messrs. Gilbert Walker and Donald Campbell on behalf of the proposed South African Steel Corporation, Ltd., for the erection in the Transvaal of a plant for manufacturing steel from iron and steel scrap. The capital is £200,000, and the initial plant is to consist of a 5-ton Héroult electric furnace, electric power being obtained from the new power station to be erected at Tweefontein. The Corporation is to test the Transvaal iron ore deposits. The Tweefontein station may also obtain a consumer in a proposed electro-chemical works for the manufacture of nitric acid, cyanide, calcium carbide, fertilisers, &c.—*Board of Trade Journal.*

NATAL.—By the borough electrical engineer's last monthly report matters electrical are going ahead in Durban, the demands for lighting and power necessitating an immediate increase of plant at the power station; last month alone there were 41 new consumers added, which is highly satisfactory after 11 years' running.

At the last Council meeting the borough electrical engineer advised the removal of two of the existing 400-H.P. tramway generators and the installation in their place of two 2,000-KW. turbo-alternators, and in addition the purchase of other plant as follows:—One 500-KW. convertor for tramways; one switchboard for convertor; one large boiler; one barometric-jet condenser with pumps; two 500-KW. rotary convertors; high-tension cable for mains extensions. The Committee recommended that the borough electrical engineer be authorised to call for tenders for the two 2,000-KW. alternators, with an alternative price for one 4,000-KW. alternator. The recommendations were acquiesced in.

Stockport.—Experiments in street lighting with 1,000-C.P. and 400-C.P. Osram metal-filament lamps are being carried out.

Stockton-on-Tees.—The Bowesfield Steel Co., Ltd., who specialise in the manufacture of black, galvanised and corrugated steel sheets, have recently arranged for the installation of an additional plate-rolling mill, which is to be electrically operated; a contract for electrical machinery of 750 H.P. has just recently been awarded to Messrs. Dick, Kerr & Co., whilst the current will be taken from a sub-station established on the works site by the Cleveland and Durham Electric Power, Ltd.

Walthamstow.—Application is to be made to the L.G.B. for sanction to borrow £1,838, being the estimated expenditure for three years on mains extensions, house services, &c. The amount mentioned is made up as follows:—One mile of distributor cable, including junction boxes, troughing, laying, &c., £750; 250 house services at £4 per service, £1,000; amount over-expended on previous loans, £88.

TRAMWAY and RAILWAY NOTES.

Australia.—A recent issue of the *Australian Mining Standard* says that, having in view the discussion as to municipal or Government control for the Melbourne tramways after the expiry of the present agreement with the M.T. & O. Co., it is interesting to note that an effort is being made in Sydney to obtain the transfer of the tramways from the Railways Department to the City Council. The latter has passed a resolution that the time has arrived for such amendment of the Local Government Act, 1906, as shall permit local authorities to acquire tramlines from the Government. On the other hand, the new Premier of South Australia, Mr. Verran, recognises the undesirableness of competition between tramways and railways, and in reply to a deputation which asked him recently for a railway or electric tramway to Brighton, 10 miles south of Adelaide, he said something must be arranged between the railways and the Municipal Tramways Trust. If the Trust intended to run tramways to Edwardstown and Brighton, there was no need for a railway.

Belfast.—The following are the proposals for the extensions of the tramways system of this city, which have been approved by the Corporation. (1) Donegall Road tramway, commencing with a junction with the existing tramways in Shaftesbury Square, proceeding along Donegall Road, and terminating by a junction with the existing tramways in Falls Road; cost of construction, £22,000. (2) Shaftesbury Square and Ormeau Road junction tramways, commencing with a junction with the existing tramways in Shaftesbury Square, proceeding along Botanic Avenue and University Avenue, and terminating by a junction with the existing tramways in Ormeau Road; cost, £12,000. (3) Stranmillis Road extension, commencing with a junction with the existing tramways in Stranmillis Road at their termination, proceeding along Stranmillis Road, and terminating at a point on that

road opposite the first lock (River Lagan); cost, £6,000. (4) Ligoniel extension, commencing with a junction with the existing tramways at Ligoniel at their termination, proceeding along Ligoniel Road, and terminating at a point on that road opposite Mill Avenue. Cost, tramway, £6,000; altering road level, £450—Total, £6,450. (5) M'Art's Fort tramway. (6) Castlereagh Road tramway, commencing with a junction with the existing tramways at Mountpottinger, proceeding along Castlereagh Road, and terminating in that road at the city boundary. Cost, £23,000. (7) Bloomfield tramway, commencing with a junction with the existing tramways in Woodstock Road, proceeding along Beersbridge Road and Bloomfield Avenue, and terminating at a point in the latter thoroughfare at its junction with North Road. Cost, £17,000. (8) Old Lodge Road and Oldpark tramway, commencing with a junction with the existing tramways in Peter's Hill, proceeding along Old Lodge Road and Comber Place, crossing Crumlin Road, proceeding along Oldpark Road, and terminating by a junction with the existing tramway at the terminus of the Cliftonville Road tramway, cost £25,000. For the M'Art's Fort tramway, which crowns the Cave Hill, overlooking the city at a height of over 1,100 ft., there are alternate schemes by way of the Horseshoe Road, across marshy grounds direct from the village of Ligoniel to the mountain, at a cost of £94,580. A second scheme would embrace the acquisition of certain lands on the mountain and the laying of them out in streets of artisan's houses to the number of 1,700, lands for a public park and tea gardens. This latter scheme will be carried into effect in all probability. The estimated cost of the eight new lines and extensions will work out at someting like £151,000, and £10,000 for road making.

Continental Notes.—SWEDEN.—The plans for the electrification of the Gelliyaarre Railway, running from the well-known iron deposits and mines in Swedish Lapland to the Norwegian border, have been steadily progressing, and the railway authorities have signed a preliminary contract with the Allmäna Svenska Elektriska Co., at Vesteraas, and Siemens-Schuckert, of Berlin, who are acting jointly in this matter, for undertaking the electrification, at a cost of £284,000. The tender has been accepted, subject to the electrical energy being obtainable at such a price, that the electrification will pay. The authorities have not yet decided which particular waterfalls are to be selected for the supply of the necessary electrical energy. The contractors will have to provide the whole of the capital without being reimbursed in the ordinary way. The Government, however, is to pay a fixed rate of interest on the capital, besides amortisation. The Government has the right of taking over the railway at any time, and at short notice, and paying the contractors right out. After the expiration of 25 years the Government will enter into full possession of the line without any payment whatever. If the conditions stated in the contract are not fulfilled, the contractors will be obliged to remove the electrical plant, and to reinstate the railway in its former condition. A certain rate to form the basis as to the cost of running the railway has been agreed upon by the contracting parties. If this rate is exceeded, the contractors will have to pay the Government the amount in excess. But, on the other hand, if the running expenses are lower than the fixed rate—and this is the chief point where the prospective profits of the contractors come in—the difference is to be divided, two-thirds going to the contractors and one-third to the Government. The chief object of the contractors must, therefore, be to reduce the running expenses as much as possible, so as to increase the difference between the same and the guaranteed rate, and, consequently, their own profits.

GERMANY.—After negotiations extending over several years between the interested local authorities, the supervising authorities and the Berlin Elevated and Underground Railway Co., the latter has now received the sanction of the police to the further extension of its network in the west of Berlin. It has been exceedingly difficult in connection with the proposed new lines to reconcile the traffic wishes of the towns of Charlottenburg and Wilmersdorf. It was only after the repeated intervention of the Minister for Railways that a solution was found which offers to the projected Wilmersdorf and Dahlem Railway a junction with the existing network at the underground station at the Wittenberg Platz, and, at the same time, assures to the town of Charlottenburg the contemplated underground line to the Kurfurstendamm, which is in the first place to be constructed to Uhlandstrasse. The sanction of the police authorities comprises the reconstruction of the railway stations at Wittenberg Platz and the construction of both of the two new lines proceeding from this station, which is to be converted into a joint station with five tracks and three platforms. The traffic on the two lines will first be worked on the shuttle system which will ultimately be replaced by through-working. It should be added that the railway being built for the town of Schoneberg is expected to be completed in the course of a few months to the Nollendorf Platz, in direct vicinity of the existing elevated company's station, and passengers from the one railway will be able to reach the other by means of staircases.

A company is being formed with a capital of £600,000, under the auspices of the Allgemeine Electricitäts Gesellschaft and the Siemens-Schuckert Werke Gesellschaft, to construct an express electric railway between Cologne and Dusseldorf.

RUSSIA.—A Belgian company, which constructed and controls the electric lighting and tramway in Sevastopol, has recently obtained a concession for the construction of an electric tramway, &c., at Simpheropol, the chief town of the Crimea.

HOLLAND.—The Nimegen authorities have decided to take over, on behalf of the town, the working of the steam tramways, and to substitute electric for steam traction at a cost of over £80,000.—*Board of Trade Journal.*

Edinburgh.—At a meeting of the Corporation Tramways Committee a proposal was submitted for the placing of a guard in front of the cable cars to pick up children falling in front of them. The Committee instructed the burgh engineer to communicate with the makers of such contrivances, and inquire into the practicability of the suggestion.

Halesowen.—The Light Railway Commissioners, as a result of the recent inquiry, have decided to grant a separate order authorising the Birmingham Corporation (subject to mutual traffic facilities being granted) to instruct and work railway, No. 5, in Beech Lanes, and by agreement with the Halesowen Light Railway Co. to purchase so much of railway No. 1 running through Halesowen and Quinton as lies jointly in the city of Birmingham and the Urban District Council of Oldbury, provided the City Council will pass a special resolution under the Light Railway Act (1896) applying for the order, and will, by resolution, undertake to complete railway No. 5, so that it shall be ready for inspection by the B. of T. at the same time as the other Halesowen railways are inspected. The Birmingham Corporation Tramways Committee has accordingly recommended the City Council to pass these resolutions.

Herts.—The C.C. has decided, subject to the consent of each local authority being obtained, to promote a Bill in Parliament, for the provision of an omnibus service at Watford and Bushey, to be operated on the trackless trolley system.

Huddersfield.—The financial statement respecting the Corporation tramways for the three months ended June 30th, 1910, shows that the income amounted to £23,528, or 11·09d. per car-mile, compared with £22,571, or 10·59d. in the corresponding quarter of last year. The total working expenditure was £14,152, or 6·69d., compared with £11,449, and 5·27d. in 1909. The gross surplus was £9,376, against £11,122 last year; and the net surplus £3,315, or 1·56d. per car-mile, compared with £5,072, or 2·38d. last year. After allowing for depreciation at 3 per cent. (£3,062), there is a net surplus of £253.

The question of carrying out the proposed extensions to Birchencliffe and Newsome has been deferred.

Japan.—According to B. of T. information, three syndicates have approached the Formosan Government for concessions for the construction of electric tramways in Taihoku, a city with a population of 84,000.

London.—At the half-yearly meeting of the East London Railway, Lord Claud Hamilton, M.P., who presided, said that he believed their only policy was electrification, and he thought the best system was that adopted by the Metropolitan and the District Co.'s. The overhead system, in view of the many tunnels, would not be suitable for the East London. Unfortunately the six lessee companies were not yet prepared to adopt the suggestion. Lord Claud quoted the success which had followed electric working on the Mersey Railway, which was a very similar line to their own. He proposed to approach one or two of the great electrical companies, and see whether they could submit a scheme under which, for payments extending over several years, they would undertake to carry out the entire work of electrifying their system. He would then be able to go with a concrete proposal to the six lessee companies, and he hoped with success, and ask them seriously to consider the question. The electrification of their line would directly benefit two of the lessee companies, viz., the Metropolitan and the District, allowing of through traffic over their lines.

The Brighton Railway Co.'s report for the past half-year states that the electrical trains on the South London Railway continue to work very successfully, and the increase of traffic since the services were established is still maintained. The board has decided to extend the system to other parts of the suburban area served by the railways of the company, and the work of equipping the line from Peckham Rye, where a junction is made with the South London Railway, through Tulse Hill to the Crystal Palace, has already been commenced.

Malvern.—With reference to the proposed funicular railway on the Malvern Hills, the Light Railway Commissioners have intimated that they are prepared to grant an order for the construction of the line, subject to the consent of the Board of Agriculture being obtained to run over common land.

Rawtenstall.—The T.C. has decided that as soon as Parliament has confirmed the Corporation Tramways Order, application be made to the B. of T. or to the L.G.B., or to both, as the case may require, for sanction to borrow £35,933 for constructing and equipping the proposed tramways along Whitewell Valley, from Waterfoot to Dean Lane, also that application be made for sanction to borrow £5,000 for extending the car-shed, workshop and offices of the tramway depôt in Bacup Road.

Whitworth.—On the 20th inst., Col. Druitt, of the B. of T., inspected the new length of electric tramway from Church Street, Whitworth, to Station Road, Facit. He expressed satisfaction with the track and equipment, and sanctioned immediate running. The lines had been laid as far as the Red Lion Hotel, Shawforth, leaving only about 3 miles to link up Rochdale with the Bacup and Rossendale system. The through lines joining the two boroughs of Rochdale and Bacup will probably not be completed before the autumn.

TELEGRAPH and TELEPHONE NOTES.

Australia.—It appears that the telephone system in Victoria has made a loss, consequent on the partial and permissive introduction of the toll system, which is obligatory only on new subscribers. The natural consequence has been that all large users of the telephone have remained on the flat rate, and small users have preferred the toll rate, as might be expected. It is reported that in 1908-9 there was a loss of nearly £8,000, whereas if the flat rate had been retained there would have been a profit of £20,000. An inquiry into the cost of working the telephones has revealed the fact that the telephone and telegraph accounts have been hopelessly intermingled, and no proper system of accounting has been followed in Victoria. The expenses rose from £66,383 in 1906-7 to £100,455 in two years, while the revenue increased by only £4,132.

Hamburg Telephone Exchange.—Referring to the note on page 135 of our last issue, the Adnil Electric Co., Ltd., inform us that the exchange in question was constructed by the Deutsche Telephonwerke, of Berlin, for whom they are sole British agents.

Natal.—The receipts for telegraph work for the financial year ended June 30th, 1909, amounted to £43,058; during the year ended December 31st, 1909, 1,513,712 telegraph messages were dealt with by the 213 telegraph offices throughout the Colony. The revenue derived from the telephone department during the year totalled £10,844, being an increase of 13·1 per cent. over last year's amount.

Knudsen System of Telegraphy.—Last week a demonstration was given of the express system of telegraphy invented by Mr. Hans Knudsen, which, it is claimed, can effect an economy of 75 per cent. in the time required to transmit messages by cable. Only one impulse is required per letter, the identity of the letter being established by the distance of each dot on a recording tape from the preceding dot. The daily Press shows much interest in the idea.

South African Cable Traffic.—The revenue of the Associated Cable Companies from the whole of the South African traffic during the year 1909 is estimated at £283,054, and the full subsidy will therefore (says the Postmaster-General in his annual report) be payable by the supporting Governments for the fourth year in succession. The year, nevertheless, shows an increase of 16·9 per cent. in the value of cable traffic, and the standard revenue of £300,000 required by the companies before the payment of subsidy is affected appears to be within measurable distance of being attained once more.

Communication with Trains.—Experiments have been carried out on the Brighton Railway, between Horley and Three Bridges, by Mr. H. von Kramer, with successful results. A double line of wire was laid on the sleepers, and a brake-van was equipped with telephone apparatus and a receiving coil; by this means communication was maintained with a signal-box at Three Bridges while the train was travelling at full speed.

Wireless Telegraphy.—The utility of wireless stations on shipboard has been doubly instanced during the past week. The ss. *Momus*, from New York for New Orleans, caught fire off the coast of Florida; a sister ship was summoned by wireless and took off the passengers, afterwards standing by the *Momus*, which is likely to reach port. The presence on board the ss. *Montrose*, from Antwerp for Quebec, of persons suspected to be Dr. Crippen and his typist, Miss Le Neve, was similarly signalled to land, and a detective was dispatched in the *Laurentic* to meet them on landing.

It is reported that the Minister for External Affairs of the Commonwealth of Australia is going to call for tenders for wireless stations at Port Moresby and Cape York.

In reply to a question on Monday, Mr. Herbert Samuel said the following stations in the United Kingdom might be useful to ships sailing to or from India: North Foreland (Kent), Niton (Isle of Wight), Bolt Head (Devonshire), Lizard (Cornwall), Seaforth (Liverpool), Rosslare (Wexford), Crookhaven (Kerry). A station at Bombay was recently opened for general communication with ships. Apart from these, two stations in Egypt (viz., at Port Said and Port Tewfik) belonging to Lloyd's were open for communication with ships on matters relating to navigation. There were also Government stations at Gibraltar, Malta and Aden, which, though not open for general purposes, would communicate with ships in case of distress. The question of opening stations at these and other places for general communication with ships was under consideration.

The first Marconi wireless telegraph station on the South African coast, which has just been established on the Bluff, Durban, and put into public service, is a 3-KW. station with a minimum guaranteed range of 250 miles, but under very favourable conditions communication was effected with an Australian-bound boat at a distance of 1,050 miles. Very few vessels on the South African coast are fitted with wireless apparatus, but after the establishment of a station there is no doubt that the principal boats will follow suit. The charge for public messages is at the rate of 11d. per word.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—August 2nd. 1,820 private letter-box fronts for the P.M.G.'s Department in Victoria, Queensland, South Australia and Western Australia. See "Official Notices" June 17th.

MELBOURNE.—August 16th. Bare hard-drawn copper cables (3 tons 2 cwt.) for the Corporation. See "Official Notices" to-day.

August 30th.—Electrical sundries, insulators, wire and sulphate of magnesia, for the Deputy-Postmaster-General, Melbourne. Local representation. Specifications at office of High Commissioner, 72, Victoria Street, S.W.

September 7th. Battery material and glassware for P.M.G.'s Department in Queensland. See "Official Notices" July 22nd.

August 30th. Telegraph and telephone material, for the P.M.G.'s Department in Victoria. See "Official Notices" to-day.

Austria.—The State Railway authorities in Vienna are inviting tenders until August 7th for the establishment of an electric lighting plant at the railway station at Pardubitz.

Chelmsford.—August 31st. Supplying and fixing wiring for lighting Trinity Road Schools by electricity, with alternative tenders for gas lighting, for the T.C. W. H. Pertwee, architect, The Institute, London Road, Chelmsford.

Denmark.—Tenders are invited for the supply to the Copenhagen Lighting Department of cables for direct current during the 11 months ending August 1st, 1911. Tenders, marked "Tilbud paa Jævnströmskabler," will be received at "Directören for Belysningsvæsenet, Raadhuset," Copenhagen, up to noon on August 4th. A copy of the conditions of tender, &c. (in Danish), may be seen by British makers at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, London, E.C.

Hungary.—August 16th. The municipal authorities of Tolun are inviting tenders for the establishment of a small central electric lighting station in the town.

India.—August 3rd. The Secretary of State for India is inviting tenders for overhead floating staging and electrically-driven water-supply pumps. Conditions of contract from the Director-General of Stores, India Office, Whitehall.

Italy.—The Naval authorities at Spezzia are inviting tenders until August 13th for the supply of a quantity of electric cables.

London.—L.C.C.—August 30th. Wiring and fitting for electric lighting of the second section of the Woolwich Road car depôt. See "Official Notices" July 22nd.

Manchester.—August 2nd. Induced-draught plant for Bloom Street generating station, for the T.C. F. E. Hughes, Secretary, Electricity Department, Town Hall.

Newport.—August 15th. Carbon-filament lamps, radiator lamps, flame arc carbons, and alternating and direct current two-rate and prepayment meters, for the Electricity and Tramways Committee. See "Official Notices" July 22nd.

New Zealand.—Power-house plant, cars, trucks and equipment, rails and fishplates, trolley wire and feeder cable, for the Invercargill B.C. See "Official Notices" July 15th.

The specifications, &c., for the supply and erection of installations of wireless telegraphy, mentioned in our last issue, may be obtained on application to the office of the High Commissioner for New Zealand, 13, Victoria Street, London, S.W. Copies may also be obtained by British firms at the Commercial Intelligence Branch of the Board of Trade.

Rochdale.—August 3rd. 4,000 tons of steam coal for the Corporation electric power station. C. C. Atchison, engineer and manager, Dane Street.

Spain.—August 16th. The Spanish Post and Telegraph authorities in Madrid are inviting tenders for the concession for the establishment and working of a telephone line in the Linares district.

Tenders have just been invited by the municipal authorities of Navarcles (province of Barcelona) for the concession for the electric lighting of the town.

Whitehaven.—July 30th. Two superheaters for two existing Babcock & Wilcox boilers, for the Corporation. See "Official Notices" July 22nd.

CLOSED.

Belgium.—No fewer than seven German firms, one French and one British firm submitted tenders to the Société Nationale des Chemins de Fer Vicinaux, of Brussels, for the supply of the underground and sub-river cables required in connection with the electric railways in the Bruges district. We are glad to be able to report that the British firm, Callender's Cable and Construction Co., Ltd., of London, succeeded in submitting the lowest tender,

Bolton.—The T.C. has accepted the tender of Messrs. E. Bennis & Co., Ltd., for two sprinkler stokers and self-cleaning compressed-air furnaces for a new boiler at the Electricity Works.

Cape Town.—The tender of Messrs. A. H. Johnson and Co., Ltd., of Cape Town, for the supply and erection of electric fire detectors and sprinklers (£1,745) at the Houses of Parliament, has been accepted.

Coventry.—The Electric Light Committee has accepted the following tenders:—

Feed-water purifier, £725.—The Harris Patent Feed-Water Filters, Ltd., Newcastle-on-Tyne.
Pipework, £3,775.—Messrs. Stewarts & Lloyds, Ltd., Birmingham.

The Committee also reported in favour of the Corporate seal being affixed to contracts with the British Thomson-Houston Co., Ltd., for the supply of a turbo-alternator for the electric light works; with Messrs. Babcock & Wilcox, Ltd., for the supply of four water-tube boilers; and with Messrs. E. Green & Son, Ltd., for the supply of two economisers.

Derby.—The T.C. has accepted the tender of Messrs. Taylor, Whiting & Taylor, of Derby, for the electric light installation at the Town Clerk's offices.

Eccles.—The Education Committee has accepted the tender of Messrs. E. M. Evans & Sons, Manchester, at £460, for electric wiring and fittings for the new secondary school at Monton.

Hornsey.—The Education Committee has accepted the tender of F. Beavan & Co. (Dartford), at £284 17s. 2d., for installing electric light in the Stroud Green School. Twenty-four tenders were received.

Leicester.—The T.C. has accepted the following tenders:

Messrs. Willans & Robinson, Ltd.—Steam turbine with Siemens generator, £7,353.
Messrs. Yates & Thom, Ltd.—Steam-raising plant, £2,686.

Littleborough.—The Tramways and Electricity Committee has, subject to L.G.B. approval, accepted the tenders of W. T. Henley's Telegraph Works Co., Ltd., London, for work in connection with the electric lighting undertaking, as follows:—

(*a*) Supplying of H.T. feeder cables and L.T. distributors, and the carrying out of certain road work.

(*b*) Supplying and erecting of transformer kiosk in the "Square," with the necessary transformers, and equipment and switchgear in the sub-station.

London. — STEPNEY. — The following tenders were received by the B.C. for the supply of power and lighting distribution boards at the Limehouse station:—

	Power board.	Lighting board.	Total.
Edison & Swan U. E. L. Co. ..	£123 9	£12 0	£135 9
Kelvin & J. White, Ltd. (not in accordance with specification)	130 2	21 8	151 10
General Electric Co., Ltd. ..	142 0	22 0	164 0
A. W. Penrose & Co., Ltd. ..	—	—	164 0
Elliott Bros.	144 10	22 5	166 15
W. White & Co.	154 0	16 0	170 0
Crompton & Co., Ltd.	—	—	192 0

Having regard to the design and type of the apparatus offered, the Electric Lighting Committee recommends the acceptance of the General Electric Co.'s tender for the power board, and that of Messrs. W. White & Co. for the lighting board.

HAMMERSMITH.—The Electric Lighting Committee recommends the acceptance of the tender of the Standard Cable Co., Ltd., of 18, Queenhithe, E.C., for 2,500 yards of ·025 L.T. service cable, at £181. A tender by Messrs. Aubert, Grenier & Co., at £168, was rejected.

FULHAM.—The Electricity Committee, having considered tenders submitted for 150 meters, of 3, 5, 10, 25 and 50-ampere sizes, has recommended the acceptance of an alternative tender (the lowest submitted) by the Electrical Co., Ltd., at an estimated cost of £153 10s. Nine tenders were submitted, the highest being for £208 15s.

L.C.C.—The Education Committee has received the following tenders for the installation of electric lighting in two schools:—

	St. Mark's Road (Kensington, N.).	Haverstock Hill (St. Pancras, W.).
Central Motor Engineering Co. (accepted for both schools)	£175 12 6	£240 14 6
F. A. Glover & Co., Ltd.	183 0 0	241 0 0
M. S. Smith & Co.	194 12 5	241 1 3
W. J. Fryer & Co.	205 15 0	259 15 0
Tyler & Freeman	222 0 0	277 0 0
Johnson & Phillips	222 5 0	267 5 0
E. Lawrance & Sons, Ltd.	225 0 0	258 0 0
G. Weston & Sons, Ltd.	239 0 0	278 0 0
E. Morgan	—	388 0 0
Chief engineer's estimates, comparable with the tenders	235 0 0	290 0 0

The Highways Committee recommends the acceptance of the tender of Messrs. Dick, Kerr & Co., Ltd., amounting to £21,629 12s., for the roadwork and platelaying, exclusive of the supply of rails and special trackwork, for the conduit tramways from Battersea Park Road to King's Road, Chelsea. Portions of the work may be sublet to the Anderston Foundry Co., or Wilsons, Pease & Co. (yokes); Doulton & Co., or Bullers, Ltd. (insulators); Bayliss, Jones and Bayliss, and Guest, Keen & Nettlefolds, Ltd (tie-bars, bolts, &c.); Hadfield's Steel Foundry Co. (plough and drain-boxes); and the Forest City Electric Co. (bonds).

In connection with the construction by the Metropolitan Electric Tramways, Ltd., of the extension of the existing tramways in Harrow Road, arrangements have been made for the overhead equipment to be carried out by Messrs. Dick, Kerr & Co., Ltd., and the supply and laying of cables by Callender's Cable and Construction Co., Ltd., both at schedule rates.

The undermentioned tenders from selected firms, for the supply of an electric winch at Forest Hill sub-station, have been considered:—

Ernest Scott & Mountain, Ltd., Gateshead-on-Tyne ..	£135 1 6	
Clarke, Chapman & Co., Ltd., Gateshead-on-Tyne ..	166 0 0	less 2½% dis.
Royce, Ltd., Manchester	165 10 0	
General Electric Co., Ltd., Birmingham	187 15 0	
Electric Construction Co., Ltd., Wolverhampton ..	202 0 0	

The estimate of the chief officer of tramways, comparable with the tenders, is £143.

Tenders included £15 for extra work if required. The Committee recommends the acceptance of Messrs. Ernest Scott & Mountain's tender.

The tender of Messrs. F. Mountford (Birmingham), Ltd., for 266 standard door-locks for draught screens for cars, at 7s. each, less 2½ per cent. dis., has been recommended for acceptance.

Southend.—The T.C. has accepted the tender of the Jandus Arc Lamp and Electric Co., Ltd., for 13 arc lamps, at £104 5s.

Stretford.—The Council has accepted the tender of the Tudor Accumulator Co., Ltd., for the replating of the existing battery and the supply of 24 additional cells.

NOTES.

Institution and Lecture Notes.—THE INTERNATIONAL RAILWAY CONGRESS AND ELECTRIC TRACTION.—The question of electric traction was discussed at the recent Congress held at Berne, reports being presented by representatives of Germany, Austria-Hungary, the United States and other countries. During the deliberations many differences of opinion were manifested on the subject, both from a technical and an economic point of view. As a consequence of this circumstance and of the inadequate clearing up of the situation the congress, while consenting to the recording of the united conclusions of the German reporters on the question, adopted a general expression of opinion stating that electric train haulage has made good progress in recent years in a technical respect, so that it is possible to solve the problem of working main lines in a satisfactory manner, whether by the use of locomotives for high speeds and heavy loads or by the employment of motor cars. This problem can be solved by various electrical systems of traction, the adoption of one or another being a question of conditions. The congress invited those railway administrations which propose to introduce electrical working on their lines to arrive at a mutual understanding in order to facilitate the passage of rolling stock over the various systems as much as possible. On the other hand, the conclusions which the German reporters failed to induce the congress to adopt were as follows:—(1) The form of current is not to be selected according to the special advantages for individual lines, but from the beginning with consideration to suitability for large networks; (2) The introduction of electrical working promises to yield considerable economies on definite sections as compared with steam locomotion, especially by the utilisation of water powers capable of storage, and by the adoption of electrical operation it is possible to increase the capacity of a railway without fresh expenditure for technical constructional works; (3) According to the present position of technical science, the single-phase system represents for the conditions in Germany, Austria and Switzerland, the form of current which is best adapted to the requirements of main line working; although the polyphase current, as well as the direct-current system, has also in many cases proved equal to these requirements; (4) A periodicity of between 40/3 and 50/3 seems the most suitable for the single-phase alternating current, and a pressure of from 10,000 to 15,000 volts in the working conductor is admissible and sufficient.

CANADIAN ELECTRICAL ASSOCIATION.—At the twentieth annual convention of the Canadian Electrical Association, held at the famous summer resort, Muskoka Lakes, on July 6th to 8th, a very enjoyable time was spent by the members and their friends. The officers elected for 1910-11 were:—President, P. S. Coate, Ontario; first vice-president, E. A. Evans, Quebec; second vice-president, W. L. Adams, Ontario; secretary-treasurer, T. S. Young. Managers' Committee: J. J. Wright, R. S. Block, R. F. Pock, L. V. Webber, A. L. Mudge, D. H. McDougall, Toronto; W. C. Bria, Fort William; W. Rijersen, Duluth, Minn.; A. F. Dion, Ottawa; F. O. Chilsom, St. John, Quebec.

Mr. A. A. Dion (Ottawa) read a paper prepared by Mr. A. S. Loizeaux (Baltimore, Md.) on "The Protection of Service in Large Electric Systems." Speaking from experience, Mr. Dion emphasised the great appreciation of the public to-day of an assured continuity of service, even when it was found necessary to charge higher rates for such service. Consequently, the fact that municipal plants claimed to have lower effective rates was no indication that the private companies would lose customers.

Mr. Chas. Scott, of Pittsburg, Pa., U.S.A., past-president of the American Institute of Electrical Engineers, read a paper on "Transmission Line Regulation."

The report of the Committee on grounding of transformer secondaries, was received. It was presented by Mr. A. A. Dion, Ottawa. The question of the protection of life, including employés, from the dangers of exposed electric wires, is of particular moment in Canada at present.

Mr. H. S. Bunn showed that electric heating apparatus was more economical than gas. This was something new to the members. In a series of tests made, the superiority of electric appliances was demonstrated. Ottawa will probably be the next place of meeting.

INSTITUTION OF CIVIL ENGINEERS.—The King has been graciously pleased to become patron of the Institution, of which he was an honorary member for 17 years before his accession to the Throne.

INSTITUTION OF MECHANICAL ENGINEERS.—The joint meeting with the American Society of Mechanical Engineers commenced on Tuesday at Birmingham; about 200 members of the latter society and ladies, arrived from America on Monday, and were welcomed by the president, Mr. J. A. F. Aspinall, and the secretary, Mr. E. Worthington, at Liverpool. The Conference in Birmingham occupied Tuesday and Wednesday; yesterday visits were made to Stratford-on-Avon and other places and to-day the Conference reassembles in London. Several papers on the electrification of railways will be discussed to-day.

The International Glow Lamp Syndicate.—A Vienna Press correspondent reports that conditions have recently arisen in connection with the International Glow Lamp Syndicate which bring the premature dissolution of the combination within the range of possibility. As will be remembered, the syndicate which was formed in 1903 as the Sales Bureau of the United Glow Lamp Works Co., of Berlin, comprises 18 constituents represented by the leading firms in Germany, Austria-Hungary, Sweden, Holland, Italy and Switzerland, and the currency of the agreement extends to the year 1914. The German firms include the A.E.G., the Siemens & Halske Co. and the Pintsch Co. It is stated that the profits of the syndicate in the past five years have declined to one-third of those formerly realised. The cause is not to be found in a reduction in the sales, as these have remained on the same level of about 30,000,000 lamps per annum. There has, however, been no advance in the turnover, as the natural growth in business has been absorbed by the extension in the use of metallic-filament lamps. The situation in Germany is mainly attributed to the introduction of taxation on glow lamps according to the consumption in watts, which is tolerably high in the case of carbon-filaments and much less in regard to metallic-filament lamps. On the other hand, a number of lamp works outside the syndicate has arisen recently in other countries, whilst the French makers, who for some time belonged to the syndicate by way of trial, have now retired from it. In these circumstances and in view of the increasing sales of wire lamps, it is feared that the turnover of the syndicate will in a short time fall to the minimum of 23,000,000 lamps per annum. Although the basic prices for carbon-filament lamps have not been lowered, notwithstanding the competition of wire lamps and of outside makers, the profits of the syndicate have been diminished owing to the increase in the rebates on sales. It is therefore considered uncertain whether having regard to these conditions it will be advisable to maintain the syndicate until 1914. It is, however, possible that as all carbon lamp works now also manufacture metallic-filament lamps, this may lead to endeavours to rearrange the basis of the syndicate by the inclusion of wire lamps within the sales organisation in the future.

Educational Notes.—The Council of the City and Guilds of London Institute has awarded the Diploma of Associate to 50 students at the Central Technical College, in Civil and Mechanical Engineering, 25 in Electrical Engineering, and 5 in Chemistry, who have completed the prescribed course of instruction. The Bramwell Medal has been awarded to Mr. W. E. Bullock, and the Siemens Memorial Medal and Premium to Mr. J. D. Peattie. Certificates have been awarded to 19 students of the Central Technical College, and to 56 students of the Technical College Finsbury.

NORTHAMPTON POLYTECHNIC INSTITUTE.—Full-day courses in mechanical and electrical engineering and electrochemistry, will commence on October 3rd; they include periods spent in commercial workshops, and extend over four years. The course in electrical engineering includes radio-telegraphy. Technical optics is the subject of another course.—See our advertisement pages to-day.

UNIVERSITY COLLEGE.—The session of the Faculty of Engineering begins on October 3rd. Prof. Cormack is at the head of the mechanical engineering department, and Prof. Fleming at that of the electrical engineering, with Mr. H. M. Hobart as special lecturer on electrical design. Intending students should communicate with the Provost at once

UNIVERSITY OF LIVERPOOL.—The session commences on October 4th. Prof. E. W. Marchant is head of the Electrical Engineering department, and Prof. W. H. Watkinson of the Engineering department. Railway Engineering is under the guidance of Mr. J. A. F. Aspinall, and Municipal Electrical Engineering is taught by Mr. A. Bromley Holmes.

Bowling Competition.—On Saturday last the first annual bowling competition was held on the new Green at the works of the St. Helens Cable and Rubber Co., Ltd. There were 84 entries for prizes of sets of bowls presented by Mr. T. O. Callender and Mr. James Taylor, directors. The Green, having accommodation for six sets of bowlers, was constructed by the staff without expense to the company, early this year, and is situated in a corner of the works yard. Such an arrangement is probably unique in an electrical engineering works.

Copper.—Messrs. Merton's report for mid-month, now to hand, shows visible supplies at 102,659 tons, a reduction of 1,298 tons since the end of June. Since the end of February, when supplies stood at their highest, the reduction has been 10,796 tons, or at the rate of 2,374 tons per month, so that the present reduction is still average. The quantity has been withdrawn from English ports, the French stock of 6,471 tons being an advance of 126 tons on that for the end of June. Quantities afloat from Chile and Australia are both up, 75 tons for the former and 525 for the latter. Supplies from North America are considerably increased, being 18,652 tons for the half-month, equal to the average whole monthly supply since March. Spain and Portugal are rather low, Chile shipments increased, and Australia well up to average. The deliveries are also full, so that, unless the latter half shows a falling off, demand appears to be briskening.

B.T.-H. Fire Brigade Successes.—We have noted with interest each year the appearance of the B.T.-H. Works Fire Brigade amongst the prize winners at the annual camp competitions of the National Fire Brigades Union. This year the camp was held at Southend-on-Sea, when the brigade were even more successful than in previous years in the competitions and drills. In all of the eleven events for which they entered the brigade succeeded in getting placed well up amongst the best fire brigades of the kingdom, securing no less than three first places, four thirds, two fourths, one eight, and one eleventh. The prizes included—for the second year in succession—the National Hose Cart Challenge Shield, which is one of the "blue ribbon" trophies of the N.F.B.U.; representatives from every district of the Fire Brigade Union being elected to compete in the event. In the combined Life-Saving and Practical Competitions ("problem" drills) the brigade secured two third places and a fourth, a meritable performance in view of the fact that they were the only private brigade which entered for these competitions, and were opposed by some of the best town brigades in the country.

Public Works Loans.—According to the thirty-fifth annual report of the Public Works Loan Board, not a single loan was advanced during 1909-10 to local authorities under the Electric Lighting Acts, but nearly 50 amounts were outstanding at the end of the financial year.

Fulgurites.—In *Nature*, of July 21st, Mr. R. W. Wood, of Long Island, describes a remarkable fulgurite, of which he obtained a cast recently. A lightning discharge struck a lawn, within 50 ft. of the spot where he stood; there was a bright flash of light at the surface of the ground, and a column of steam or smoke some 6 or 8 ft. in height. Three patches of withered clover were found where the discharge had struck, with deep holes in two of them, the larger being an inch in diameter; Mr. Wood melted a quantity of solder and poured it into this hole, obtaining a cast nearly 4 ft. long, with lateral branches. The ground was very wet at the time, after much rain.

Inspectors of Mines.—The Home Secretary has announced that the statements which have appeared in the Press regarding the appointment of inspectors are unauthorised; if any appointments are decided on, full particulars will be published in due course.

Wireless in German Fisheries.—United States Consul-General Robert P. Skinner, at Hamburg, states that three Cuxhaven steam trawlers are now equipped with wireless telegraph apparatus, and the service is so satisfactory that efforts are being made to increase it. The most marked advantages resulting from the use of the wireless telegraph in this business are the ability of captains to advise each other at sea as to their respective catches, and the transmission of similar reports to Cuxhaven a number of hours before the return of the ships to port. Thus vessels of the same fleet which have found poor fishing are sometimes able to join other vessels more fortunately located, in time to return with good catches. All the vessels are then able to inform the managers of the public markets respecting the quantities of fish to be placed on sale, in such manner that in the event of unusual catches arrangements can be made in advance for distributing supplies in the least possible time. —*Electrical World.*

Fatality.—At Blaydon-on-Tyne on the 23rd inst., Deputy-Coroner Shepherd held an inquiry into the death of William James Barrett, a deputy overman, 48 years of age, who was electrocuted at the Bessie Drift, Blaydon Burn, on the 21st inst.—Robert William Barrett, a son of the deceased man, said the bell of the telephone commenced to ring and his father took hold of it. He called out "Oh, Bob," and was unable to relax his hold upon the receiver.—Another deputy overman named John Charles Todd stated that he, too, received a shock when he took hold of the telephone, and he sent word for the current to be cut off. Later when he went back he found Barrett lying on his back, near the telephone, and the doctor stated the man was dead.—Walter Hull, head electrician to the Priestman Collieries, Ltd., said that a steam pipe had recently been placed in the drift. Below this was an iron pipe containing cable for conducting a supply of electricity to the pick-sharpening shop. The steam pipe had evidently come in contact with the iron pipe, and the pressure had caused one of the joints to break, with the result that the insulation became damaged by the loosened pipe end. The current would then travel to the telephone wires. The current was 256 volts. This was not sufficient to kill a man instantaneously. Witness had received 1,000 volts under such conditions.—A verdict that the man was accidentally electrocuted was returned.

X-Ray Victims.—It is proposed to place a memorial of Mr. H. W. Cox in the Town Hall, Hackney, the borough where he resided.

X-Ray Installation.—Loughborough Hospital has received, through the generosity of Mrs. Perry Herrick, of Beau Manor, an X-Ray apparatus. The installation has been selected on the advice of Mr. W. H. Allen, the borough electrical engineer, who has supervised the whole of the arrangements, and will assist in demonstrating and operating with the apparatus.

Appointments Vacant.—Assistant lecturer and demonstrator in electrical engineering, for the Birmingham University; six shift engineers (£35 per month); three boiler house superintendents (£35); six senior switchboard attendants (£25), and six junior switchboard attendants (£21), for the Victoria Falls and Transvaal Power Co.; sub-station attendant, for the Stepney B.C. (30s.). See our advertisement pages in this issue.

According to the *Canadian Engineer*, the Winnipeg Board of Control is to advertise for a business man to manage the sale of power, commencing work on October 1st. Apply Magnus Peterson, secretary, Board of Control.

Football.—The Electrical Football League have a few vacancies for clubs connected with the electrical industry. Full particulars from Mr. C. Phillips, 140, Minet Avenue, Harlesden, N.W. Referees with vacant dates please write to Mr. Fraser, 100, Bishop Road, Fulham, S.W.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—MR. A. S. ESSLEMONT, who has for many years been manager of the County of Durham Electric Power Supply Companies, will shortly resign his position in order to specially devote his time to the development of electro-metallurgical and other process work on Tyneside on behalf of the Newcastle-on-Tyne Electric Supply Co.

MR. ALFRED COLSON, late gas and electricity engineer to the Leicester Corporation, who died on May 27th, left estate valued at £25,219 gross, with net personalty £18,353.

The Alloa T.C. has appointed MR. H. A. TULLOCH as electrical engineer-in-charge of the new generating station.

The York Electricity Committee has recommended the increase of the salary of MR. TURNBULL, station superintendent, from £150 to £165 per annum, rising by £10 a year to £175; and that of MR. G. H. HOLMES, charge engineer, from £110 to £120, with a further increase of £10 next year.

MR. G. D. VICKERS, who was appointed assistant electrical engineer to the Watford Urban District Council, has declined to take up the position, owing to his firm at Smethwick having granted him an increase of salary. MR. R. B. H. CRAGG, of Bermondsey, has been appointed to the post.

General.—MR. HENRY W. BOWDEN and MR. WILLIAM BOBY have entered into partnership as consulting engineers, at Salisbury House, London Wall, E.C. Mr. Bowden also retains his offices at 30, Craven Street, Strand, W.C., for the present.

MR. T. W. W. MELHUISH, chief electrical engineer of the Imperial Continental Gas Association, whose name older readers will remember in connection with electric lighting in the early days in Vienna, completes, on 31st inst., 25 years' service with the above Association.

MR. E. K. SANGTON, general manager of Messrs. Fraser and Chalmers, Ltd., engineers, Erith, has been appointed resident director at Erith for the company. He is succeeded as general manager by MR. F. L. WHITMORE, assistant general manager.

On July 20th, at Cardiff, MR. S. KENNETH BROADFOOT, son of J. R. Broadfoot, of Southport, was married to Miss Lucy Adeline Ferguson, elder daughter of J. S. G. Ferguson, of Cardiff, and granddaughter of the late Rev. David Ferguson, M.A., of Westerdale, Caithness, N.B.

Obituary.—MR. T. HURLEY.—The death occurred on July 20th of Mr. Thomas Hurley, a member of the firm of Gent and Hurley, electricians, of Leicester. He was in his seventieth year.

MR. GEORGE FLETT.—It is with the deepest regret that we announce the death of Mr. George Flett, managing director of Messrs. Dick, Kerr & Co., Ltd., and other important companies. On Wednesday afternoon Mr. Flett was proceeding in a motor-car to New Street Station, Birmingham, with two other directors of the Metropolitan Amalgamated Railway Carriage and Wagon Co., when a child ran into the road; the driver turned sharply to avoid the child, and the car, running against the kerb, was overturned. It fell upon Mr. Flett, who was severely injured, and died shortly afterwards at the General Hospital. We shall refer to Mr. Flett's career in a later issue, confining our remarks for the moment to the expression of our sincere condolences with his associates.

NEW COMPANIES REGISTERED.

Electric Furnaces and Smelters, Ltd. (110,576).—This company was registered on July 4th, with a capital of £5,000 in £1 shares, to carry on the business of smelters, refiners, treaters and amalgamators of ores and other metalliferous and mineral substances, manufacturers of electrical or other furnaces for smelting, &c. The subscribers (with one share each) are:—H. E. McCardle, 245, Barcombe Avenue, Streatham Hill, S.W., secretary; A. J. Phelps, 174, Vartry Road, Stamford Hill, N., clerk. Private company. The number of directors is not to be less than two or more than five; the subscribers are to appoint the first; qualification, £100 shares; remuneration, £100 each per annum, and 5 per cent. of the distributed profits after payment of remuneration for managing director, and a dividend of 10 per cent., divisible. Registered office, 110, Cannon Street, E.C.

G. W. Clarke & Co. (Liverpool), Ltd. (110,604).—This company was registered on July 5th, with a capital of £1,000 in £1 shares (250 deferred), to take over as a going concern the branch business of electrical engineers carried on by the Walsall Electrical Co., Ltd., in Liverpool, and to acquire from G. W. Clarke the benefit of certain licences and inventions relating to appliances and devices for indicating and recording temperature and otherwise. The subscribers (with one share each) are:—E. B. Barron, 24, Promenade, Egremont, Cheshire, gentleman; G. W. Clarke, Lynwood, Coronation Drive, Great Crosby, electrical engineer; R. T. Barnes, 24, Dale Street, Liverpool, solicitor. Private company. The number of directors is not to be less than two or more than three; the first are E. B. Barron (chairman), and G. W. Clarke; qualification, one share. Registered by Alfred H. Atkins, Ltd., 27-8, Fetter Lane, E.C.

Drills, Ltd. (110,603).—This company was registered on July 5th, with a capital of £2,000 in £1 shares, to carry on the business of engineers, founders, smiths, manufacturers and patentees of electric and other drills for mining or other purposes, and to adopt an agreement between R. S. Crawford and J. Scott for the acquisition of electric mining-drills and other electrically-driven percussive tools, instruments, machines and the patents in respect thereof. The subscribers (with one share each) are:—R. S. Crawford, 10, Drury Lane, Liverpool, engineer; J. Scott, 59, Merton Road, Bootle, electrical engineer. Private company. The number of directors is not to be less than two or more than seven; the first are R. S. Crawford and J. Scott (provisional directors); qualification, £50; remuneration as fixed by the company. Registered by T. T. Hull & Son, 22, Chancery Lane, W.C.

Witton James, Ltd. (110,693).—This company was registered on July 8th, with a capital of £6,000 in £1 shares (2,000 preferred), to carry on the business of manufacturers of and dealers in electrical driving equipments for printing, textile and paper-making machinery, electric blowers, flexible couplings, &c., and to adopt agreements with the General Electric Co., Ltd., of 71, Queen Victoria Street, E.C., and H. V. James. The subscribers (with 100 preferred shares each) are:—H. Hirst, 71, Queen Victoria Street, E.C., electrical engineer; A. H. Railing, 71, Queen Victoria Street, E.C., electrical engineer; A. I. S. Baron, 71, Queen Victoria Street, electrical engineer. Private company. The number of directors is not to be less than three or more than five; the first are H. V. James, A. H. Railing and A. I. S. Baron; qualification, 100 shares; remuneration as fixed by the company. Registered office, 71, Queen Victoria Street, E.C.

Dac Accumulator Syndicate, Ltd. (110,763).—This company was registered on July 13th, with a capital of £25,000 in £1 shares, to carry on the business of electrical engineers and contractors, manufacturers of and dealers in cells and batteries, suppliers of electricity, manufacturers of electrical and other apparatus, &c., and to adopt an agreement with G. Schauli, F. T. W. Price and H. E. Hughes for the acquisition of certain patents. The subscribers (with one share each) are:—G. Schauli, 63, Harberton Road, Upper Holloway, N., electrical engineer; F. T. W. Price, Ivy Bank, Addiscombe Road, Croydon, Surrey, merchant; H. E. Hughes, 90, Goswell Road, E.C., merchant; R. Safft, Goeppingen, Germany, manufacturer; J. Hopkins, 8, Kenbury Gardens, Camberwell, S.E., clerk; G. E. Croydon, 24, Toronto Road, Ilford, traveller; and R. B. Baldry, Hoddesdon Bury, Hoddesdon, Herts., merchant (200 shares). Minimum cash subscription, £2,000. The number of directors is not to be less than two or more than seven; the first are F. T. W. Price and H. E. Hughes; remuneration, £50 each for the first year and afterwards £100 each per annum (chairman, £25 extra) and a percentage of the profits. Registered office, 39, Red Cross Street, E.C.

Dartmoor Electric Supply Co., Ltd. (110,871).—This company was registered on July 19th, with a capital of £4,000 in £1 shares, to carry on at Bovey Tracey and elsewhere the business of an electric light company in all its branches, and to adopt agreements: (1) with J. H. Lee for a lease of a mill and premises at Bovey Tracey; and (2) with A. J. Wyatt relating to the supply of any surplus power required by the company. The subscribers are:—W. Aggett, Bovey Tracey, builder, 100 shares; H. A. Bentinck, J.P., D.L., Bovey Tracey, 100 shares; H. Goodwyn, F.R.C.S., Bovey Tracey, 100 shares; Lucy Hellier, Bovey Tracey, 300 shares; W. G. Hole, Bovey Tracey, gentleman, 10 shares; P. W. Peters, Bovey Tracey, grocer, 200 shares; J. A. Purves, Exeter, electrical engineer, 500 shares. Minimum cash subscription, £1,500. The number of directors is not to be less than four or more than eight; the first are W. Aggett, H. A. Bentinck, J.P., D.L., H. Goodwyn, F.R.C.S., Lucy Hellier, W. G. Hole and P. W. Peters; qualification, £10; remuneration as fixed by the company. Registered office, 12, Market Street, Newton Abbott, Devon.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Munster Electric Lighting Co., Ltd. (100,269).—Second and third debentures dated July 7th, 1910, to secure £500 and £330 respectively, charged on the company's undertaking and property, present and future, at Fethard, Tipperary. Holders: R. H. Bindloss, 26, North John Street, Liverpool; and Dargue Griffiths & Co., Ltd., 51, North John Street, Liverpool.

Canadian Electric Traction Co., Ltd. (79,722).—Return dated December 31st, 1908, filed June 21st, 1910. Capital £120,000 in £1 shares; 68,007 shares taken up; £53,000 paid on 53,007, leaving £7 in arrears; £15,000 considered as paid on 15,000 shares. Mortgages and charges: Nil.

Northampton Electric Light & Power Co., Ltd. (28,640).—Particulars of £50,000 debentures, created June 23rd and secured by trust deed dated July 8th, 1910, filed pursuant to Sec. 93 (3) of the Companies' (Consolidation) Act, 1908. Property charged: The company's undertaking and property, present and future, including uncalled capital. Trustees: T. W. Thornton, J.P., Brockhall, Northants; C. A. Markham, Northampton; and T. E. Manning, Shrubland, Dallington.

Institution of Electrical Engineers (18,393).—Mortgage and instrument of charge, both dated July 15th, 1910, to secure £11,500. Property charged: 15-18, Tothill Street, Westminster, and land in rear thereof. Holders: Economic Life Assurance Society, 5, New Bridge Street, Blackfriars E.C.

Eastern Extension, Australasia and China Telegraph Co., Ltd. (7,224).—Return dated May 20th, filed May 31st. Capital £3,000,000 in £10 shares. All shares taken up and paid for in full. Mortgages and charges: £752,400.

Eastern and South African Telegraph Co., Ltd. (13,306).—Return dated May 25th, filed June 1st. Capital, £600,000 in £10 shares; all shares taken up; £600,000 paid. Mortgages and charges, £199,500.

Western Telegraph Co., Ltd. (6,886).—Return dated May 25th, filed June 1st. Capital, £2,500,000 in £10 shares; 207,930 shares taken up; £10 per share called up on 130,000; £1,300,000 paid; £779,300 considered as paid on 77,930 shares. Mortgages and charges, £815,175.

Dynes Bros., Ltd. (109,827).—Particulars of £1,750 debentures created July 4th, 1910, filed pursuant to Sec. 93 (3) of the Companies' (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Thomas Brittan, Ltd. (110,549).—Particulars of £300 debentures, created July 5th, 1910, filed pursuant to Sec. 93 (3) of the Companies' (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's property, present and future, including uncalled capital. No trustees.

Johnson-Lundell Electric Traction Co., Ltd. (65,699).—A memorandum of satisfaction in full of mortgage dated April 5th, 1906, in respect of which £4,070 14s. 6d. was outstanding on July 1st, 1908, has been filed.

County of London Electric Supply Co., Ltd. (34,320).—Issue on July 27th of £5,000 4½ per cent. first debenture stock, part of a series of which particulars have already been filed.

Camborne Electricity Supply Co., Ltd. (57,950).—Return dated May 18th. Capital £10,000 in £1 shares; 607 shares taken up; £1 per share called up; £605 paid, leaving £2 in arrears. Mortgages and charges: Nil.

South London Electric Supply Corporation, Ltd. (50,392).—Return dated March 29th (filed May 31st). Capital £260,000 in 65,000 shares of £4 each. All shares taken up; £260,000 paid. Mortgages and charges: £100,000.

Everett, Edgcumbe & Co., Ltd.—A memorandum of satisfaction in full of debentures dated June 9th, 1905, securing £700, has been filed.

West Coast of America Telegraph Co., Ltd. (52,114).—Return dated May 24th, 1910. Capital £132,520 in 53,008 shares of £2 10s. each. 45,008 shares taken up. £2 10s. per share called up on 8. £20 paid. £112,500 considered as paid on 45,000. Mortgages and charges: £170,000.

CITY NOTES.

Metalite, Ltd.

THE exigencies of journalism last week compelled us to confine our comments on this promotion to the minimum, as our last pages were actually going to press when we received the prospectus. Since then we have been enabled to study it more closely, and to form very definite opinions as to its merits. Unfortunately, we can do little to influence the general public, who gain their information from the columns of the daily Press, and the latter, in dealing with so highly technical a subject, is not in a position to guide its readers wisely. Moreover, the promoters had skilfully and lavishly ground-baited the field of their operations. We read in the *Times* of Wednesday a statement of M. Lépine, the French Prefect of Police, to the effect that a certain banker, by the use of an extraordinary system of advertisement, made a sum of more than three millions sterling out of seven companies formed within a period of only three years; and the art is not unknown in this country also. We have not met with a single adverse comment on the prospectus in the columns of our daily contemporaries.

But what are the prospects before this concern, for which the gigantic subscription of half a million sterling is proposed? At this moment legal proceedings are pending directed against importers of tungsten-filament electric lamps, which are alleged to infringe certain letters patent. What guarantee is there that the process by which the "British Metalite" filaments are made is not an infringement of these or other patents? Again, in view of the rapidly changing aspect of the metal-filament manufacturing industry, how can any existing patent be valued at such a sum as £100,000—and that for the United Kingdom alone? It is now common knowledge that the difficult problem of drawing tungsten into wire has been solved by three of the most important electrical companies in the world; the filaments thus obtained are stated to be tougher than steel. Of what commercial value will the brittle filaments be when the wire filaments are on the market—as some of them already are?

It is interesting, and not without significance, to note that the German expert who values the British rights at £100,000, is actually one of the patentees. Naturally he would not be disposed to name a low figure. And as for seven of the nine British patents, they have not even been granted yet, but have merely been applied for, and therefore their contents have not been disclosed. Are we invited to subscribe hundreds of thousands of pounds for ungranted letters patent, which may ultimately be rejected or successfully opposed?

No weight can be attached to the report of life tests signed by one of the patentees; and as for the tests of the National Physical Laboratory, we find that they were limited to tests of candle-power and watts consumed. No life test signed by the N.P.L. is published—and the veriest tyro in the electrical industry knows well that any incandescent filament lamp can be made to give an extraordinarily high efficiency, at the cost of its life. This test is, therefore, utterly worthless without a life test also; yet the authority of the National Physical Laboratory has been adduced in an advertisement as confirming the claim that the lamps and filaments are unrivalled in cheapness and durability.

The promoters, with optimism characteristic of their kind, anticipate an annual profit of more than 30 per cent. on the entire capital as a minimum, the gross receipts exceeding a quarter of a million sterling. These remarkable estimates are said to be based upon "results obtained by the vendor companies since the perfection of the patents and processes." The British patents already granted date from 1907 (a patent *not* utilised in the British Metalite lamp) and August 16th, 1909; of those applied for, six are dated May 3rd, 1910, and one June 1st, 1910. What "results" can possibly have been obtained from these? The prospectus is significantly silent regarding the profits made in the companies' operations to date, and we surmise that there are none.

The underwriters for 150,000 shares, the minimum subscription on which the directors may proceed to allotment, are to receive a commission of 7½ per cent. and 1½ per cent. overriding commission, both payable in cash; and preliminary expenses estimated at £18,000, payable in cash. Are these the terms characteristic of a *bona fide* industrial enterprise, or of a wild-cat scheme?

The purchase price of the undertakings for which no previous profits are quoted amounts to £220,000. We are distinctly of opinion that, even if the Metalite filaments prove to be all that they are claimed to be, this sum is many times the value of the assets offered in exchange, and we strongly advise the exercise of the utmost caution by intending investors.

Liverpool Overhead Railway Co.—The accounts for the half-year show an available balance of £9,593; a dividend of 5 per cent. per annum on the preference shares (the same as last year) is recommended, leaving a balance of £5,917 to be carried forward.

Mexican Light and Power Co., Ltd.—The report states that the gross earnings for the year to December 31st were $3,014,325, and $60,823 was brought forward. The operating expenses were $648,337, and a dividend of 4 per cent. on the common stock has been paid, leaving $149,386 to be carried forward.

Continental.—BELGIUM.—La Société d'Electricite du Borinage, of Brussels, is increasing its capital from £78,280 to £100,000.

FRANCE.—La Compagnie Centrale d'Energie Electrique is the title of a new company which has just been formed in Paris with a capital of £200,000.

Dublin and Lucan Electric Railway Co. — The directors propose to pay a 5 per cent. dividend on the preference shares for the six months to June 30th, carrying forward a balance of £612. The same dividend was paid last year.

Metropolitan Electric Supply Co., Ltd. — The directors have declared an interim dividend at the rate of 4 per cent. per annum for the half-year to June 30th, as compared with 5 per cent. last year.

Fife Tramway, Light and Power Co., Ltd. — An interim dividend on the preference shares at the rate of 6 per cent. per annum for the half-year to June 30th, is announced.

Bombay Electric Supply and Tramways Co., Ltd.

THE fifth ordinary general meeting was held on Thursday last week at the Electrical Federation Offices, Kingsway, Sir Edward Sassoon, Bt., M.P., presiding.

The CHAIRMAN, in proposing the adoption of the report (see ELECTRICAL REVIEW, page 66), said it gave the directors much pleasure to be able to congratulate the shareholders upon the satisfactory progress made by the undertaking during the past year. The net receipts amounted to £82,696, as compared with £67,067; an increase of £15,528, or a little over 23 per cent. Of the sum to be set aside for depreciation, the directors proposed that £10,000 should be invested outside the business. The provision for depreciation had been based on a careful estimate of the life of what might be described as the "wasting" assets, and was, in the opinion of the board, adequate annual provision for the replacement of those assets at the end of their term of life, having regard to what they cost them. Of course, as their property grew that figure would

call for readjustment. The total revenue from all sources, including the amount represented by the sale of current to the tramways, amounted to £197,828, an increase of £19,972 over the previous year, and they would be glad to note that that additional revenue had been obtained with an increased expenditure of only £4,343. The increased revenue from the tramways accounted for £8,628 of the gross increase, and the receipts from the electrical supply branch accounted for £9,837. Dealing first with the traction branch of the undertaking during the past year, trade depression at Bombay, more particularly in the milling industry, had retarded the growth of the tramway receipts. He was sorry to say that he could not report any improvement this year, as the Bombay mill industry, like cotton manufacturers elsewhere, was suffering from the high prices of its staple commodity. On the other hand, consequent upon the excellent monsoon last year, the export trade of Bombay had been good during the current season. They would be glad to learn that the proposal for a small increase in long-distance fares on the tramways had been received by the municipal Corporation of Bombay in a sympathetic spirit. The enhanced fares came into operation on April 1st last, and the result was being very carefully watched, but some months must elapse before it was possible to gauge their full effects upon the traffic. The volume of their traffic continued to expand, although not so rapidly as they could wish. In order to deal with this expansion, the directors had found it necessary to consider the question of the provision of additional rolling stock. After making experiments with trailer cars it had been decided to construct 10 new single-deck cars, each seating 38 passengers, which would be attached to the existing cars and run as double-car trams. Coming to the electrical supply section of their undertaking, the total receipts amounted to £57,553, as compared with £47,714 in the previous year, while the working expenses were £40,935, as against £39,737, so that for an increased expenditure of about £1,200, the company had obtained an increased revenue of over £9,800. The balance carried to the profit and loss account amounted to £16,618, as compared with £7,977, or an increase in profit of £8,641. During the year under review, they secured 281 new consumers, taking a supply representing the equivalent of 36,505 8-C.P. lamps. The extension of that part of the business still continued, and up to the end of April last they had this year added a further 101 consumers. After giving the matter their most careful consideration, the directors had decided that it would be to the interests of the business to substitute flat rates for the present maximum-demand system. That alteration would apply specially to domestic consumption for lighting and electric fans, as distinguished from power consumers. The new tariff had not yet received the concurrence of the municipality, but that body and the great majority of the consumers were strongly in favour of the flat rates. The capital expenditure during the year had amounted to £41,136, of which £11,981 had been spent on the tramways, chiefly in the provision of additional rolling stock; and £25,806 in further developing the electrical supply branch, particularly in connection with the extension of mains; and the balance of £3,349 represented expenditure in connection with the issue of the second debentures. That second debenture loan was issued to meet the cost of the new power house at Kasara, which they were building and equipping. The work of erection was proceeding satisfactorily, and when the new extension came into operation, as they hoped would be the case in about nine months from the present time, they looked for important economies in their generating costs, which would become increasingly apparent as their business developed and the load on their power house expanded. The policy of the board had been to lay the foundations for a good and growing business, which the potentialities of Bombay and the progress already achieved, assured them lay ahead of the company, and with which they must be prepared to deal efficiently and economically as it came along. The board had received a good deal of advantage from the co-operation of the consultative committee in Bombay. He regretted that they had not yet been able to pay a dividend on the ordinary shares, but they had every confidence that the patience which those shareholders had had to exercise in the past would be compensated for by the growth in the profits in the not very distant future. The policy adopted by the board of making sufficient reserves for the sinking fund and allocating adequate amounts for the depreciation of their "wasting" assets must be to the advantage of all classes of shareholders, and not least to the benefit of those interested in the ordinary shares.

SIR WALTER HUGHES, C.I.E., seconded the resolution, and the report was adopted without discussion.

City and South London Railway Co.

THE report of the directors for the half-year ending June 30th, states that the receipts from all sources amounted to £88,832, and the cost of working to £42,213, leaving a profit of £46,620. Inclusive of the balance brought forward from December 31st last, the net revenue account shows an aggregate total of £47,332. After making provision for the debenture stock interest, rent charge, and the transfer to the renewal fund of £1,500, a balance remains available for dividend of £31,186. Out of this sum the directors recommend that the full dividend of 5 per cent. per annum be paid on the preference stocks, 1891, 1896, 1901 and 1903, and that a dividend at the rate of 1¼ per cent. per annum be paid upon the consolidated ordinary stock for the half-year, leaving a balance of £1,634 to be carried forward to the next account. The following table shows the number of passengers carried, exclusive of season-ticket holders, and dividends paid recently:—

Half-year.	Passengers (exclusive of ssn. tckt. hldrs.).	Receipts (including ssn. tckts.).	Div. per cent. per ann. on ord. stock.
Ended June 30th, 1905 ..	8,662,588	£71,802 7 8	2
,, December 31st, 1905..	8,607,486	70,103 14 4	1¾
,, June 30th, 1906 ..	9,045,120	72,454 3 11	2¼
,, December 31st, 1906..	9,104,293	72,223 2 4	2
,, June 30th, 1907 ..	10,048,780	77,519 11 9	2¼
,, December 31st, 1907..	10,732,145	83,451 16 4	1¾
,, June 30th, 1908 ..	10,891,535	83,474 11 3	1½
,, December 31st, 1908..	10,631,336	81,259 19 2	1½
,, June 30th, 1909 ..	11,227,179	84,245 11 10	1¾
,, December 31st, 1909..	11,234,074	84,469 5 9	1¾
,, June 30th, 1910 ..	11,497,140	88,412 11 2	1¼
Total since opening of line ..	246,390,790	£1,940,038 8 6	

The death of the King, and the ceremonies attendant thereon, had an adverse influence on the receipts. And since then, while the period of public mourning continued, the shopping and theatrical traffic has been appreciably affected. Apart from these influences the increasing competition of the tramways remained unabated, added to which the electrifying of the Brighton Co.'s line from London Bridge to Victoria has not tended to increase the receipts between London Bridge and Clapham; the interchange traffic between the tubes and other railways has also fallen below expectations. The Missionary Exhibition which proved a great attraction at the Agricultural Hall in 1909 was not held this year. The directors regret, therefore, that owing to these several causes, to increases in the wages bill and in coal and other stores, and to some exceptional repairs, they have no alternative but to recommend a diminished rate of dividend on the ordinary stock. The erection of the emergency staircase at the Brighton Co.'s end of the subway at London Bridge is completed. The Bill promoted by the Metropolitan Railway, approved by the proprietors of this company at the special meeting in February last, to authorise the construction of a low level subway at Moorgate Street to connect the stations of the Metropolitan, Great Northern and City and this railway, has passed through Committee in both Houses of Parliament. The contract for the construction of the high level subway between the Bank station of this company and that of the Central London has been placed, and the work will proceed without delay. This subway will improve the communication with the Waterloo terminus of the London and South-Western Railway, as well as with the Central London Railway. Warrants for dividends will be posted on August 5th.

The fifty-second ordinary general meeting of the shareholders of the above company was held on Tuesday at the offices, 71, Finsbury Pavement, the Right Hon. C. B. Stuart Wortley, K.C., M.P., in the chair.

The CHAIRMAN, in proposing the adoption of the above report, said the main facts that the half-year's accounts brought out were that the gross receipts were less by £731, and the expenses were more by £2,237. The result was that they had a net revenue diminished by £2,968. Increased charges for interest on money borrowed, with other things, brought the diminished net revenue down to a total balance available for distribution which was less by £3,447. They, therefore, recommended a dividend at the rate of £1 5s. per cent. instead of £1 15s. per cent. a year ago, but they carried forward £1,635 against £1,412. Turning first to the receipts, they would gather from the report some of the causes which they thought had operated adversely during the half-year. He might add to those mentioned, the fact that a General Election did much to deprive them of their normal evening traffic: also that they had to compete this year with the electrification of the L.C.C. Tramways from King's Cross to Hampstead and Highgate; likewise with the Blackfriars Bridge tramcars which now ran, at the same fares, *over* the bridge from Balham, Tooting and Clapham Common. The day of the late King's funeral alone accounted for a decrease of £200 out of the £731 lost on the gross receipts of the half-year. The Lying-in-State ceremonies also had the effect of diverting to other routes, traffic, which, ordinarily, would have been their own. The two most important things that had happened to their gross receipts last year were—firstly, the earlier running of trains on Sundays, announced last July, and begun on August 8th last; and, secondly, the reduction of local fares, also announced last July, and initiated on November 1st last. There had been also certain consequential reductions of through fares, which first took effect on May 8th of 1910. Taking first the earlier running on Sundays, he could most shortly justify the policy and explain its effect by saying that though, of course, it accounted for a substantial part of their increased wages bill and their increased train mileage, it had, nevertheless, brought them a net gain of about £15 per Sunday, or £390 for the half-year. As regarded the reduced fares, they could point first and chiefly to the fact that they had carried close on 11½ millions of passengers in the half-year; a greater number than ever before in their history, and a greater number, by close on 270,000, or 2·4 per cent., than a year ago, when the reduced fares had not come into operation. These reduced fares were, as regards through fares, forced upon them by the need of continuing to act in harmony with the policy of other tubes, with which they were in physical connection as well as organically allied by the common interest which arose from the fact that they were feeders to each other. Not only was this the case, but they believed, and still believed, that the reduction of the local fares in November was necessary to retain, under the stress of increasing competition, the patronage of the public. In the face of the increased number of passengers carried, it was impossible to say that their service was losing in popularity with the public. But they did not believe that at the old fares they would have got the new patronage, or even kept all their old customers. Reduced fares might account for reduced receipts, and they knew that they did not account for more than, at most, £500 of the £731

which was all they had to account for under that head, and some part of that £500 was to be accounted for by shorter journeys rather than reduced fares. The increase of £2,237 in expenses was owing to the fact that they had run 30,579 more train-miles than a year ago. Of these the new Sunday traffic accounted for 13,486 train-miles, or 44 per cent. The increased number of train-miles run had had the effect of reducing the receipts per train from a fraction over 18s. 3d. to a fraction over 17s. 4d., and the receipts per train-mile from 2s. 5·93d. to 2s. 4·37d. On the other hand, the total expenses per train-mile were run up from 1s. 2·11d. to 1s. 2·25d. This increase was partly due to locomotive charges, which were up from 4·52d. per train-mile to 4·70d. It was, however, not due to traffic expenses, excluding lifts, for these were down from 4·37d. to 4·32d. Lift expenses per train-mile were up from 1·76d. to 1·84d. Expenses generally had been added to by an increased weight of coal consumed of 544 tons, at an increased cost of £585, to which a rise in price had contributed at the average rate of 5¼d. per ton. Altogether stores accounted for £912 of the increased expenses, wages for £757 and repairs for £585. The increase of £757 in wages with an increased number of trains was naturally to be looked for; and, at any rate, it was not due to any general rise in the rates of wages in the half-year. That led him to speak of a matter which was of gravity, but had, nevertheless, its satisfactory side. They doubtless had seen that under what was known as the Conciliation Boards Agreement, come to in 1907, most of the railway companies had, after discussion with their men at conciliation boards, and with or without recourse to arbitration afterwards, granted certain increases of pay to their men. They had also probably noticed questions in Parliament as to whether the City and South London were going to institute a conciliation board. That company and its employés were, in one respect, differently placed to others. With them the number of men and of classes of men were, comparatively speaking, so small, and the subordinate and intermediate functionaries so few, that the men had, and always had had, access to the supreme executive for the purpose of discussing grievances or anything else, with a freedom and readiness that was seldom found possible in the case of the much larger numbers employed by the great railways. This fortunate difference between their organism and others, had been fully made use of for the current purpose of discussing rates of pay and hours of duty, on what might be called conciliation lines. And such had been the good sense and good feeling with which these discussions had been carried on, on the one hand, by fully representative deputations of their men, and on the other hand, by their excellent and popular general manager, that they were able to announce that an agreement had been arrived at which gave certain of the men advantages, either in time or money, or in both, which, whether they were more or were less than what they would have got with a Conciliation Board and arbitration, were, at all events, such that the men had set their hands to a settlement, which, after a preamble which recited that a Conciliation Board was considered unnecessary, went on to say expressly: "It is agreed that this agreement shall have the same force and effect as if a Conciliation Board had been appointed, and that it shall come into force on June 27th, 1910," and thus they waived the institution of a Conciliation Board, and allowed the company to report to the Board of Trade that at present none has been found necessary. They believed they had greatly improved the condition of the atmosphere at their Clapham Common Station by using an electrical apparatus which ozonised the air. Already their staff there told them they had found great improvement in the atmosphere, and it was to be hoped that the public would notice and appreciate the like good effects. They would watch carefully the continued working of this invention. They were studying in all directions the paramount need for improving their revenue, retaining and attracting traffic, and keeping down expenses. If they could find a way to run lighter trains during the middle hours of the day, a very large saving of current and wear and tear could be effected. If they did not find such a way, it would not be for want of ceaseless attention to this problem. If the day should come when the London and North-Western Railway brought its suburban passengers (as Parliament had authorised it to do) by a low-level line direct into their low-level station at Euston, a great accession of regular traffic should result.

The report was adopted.

Col. Perry formally moved that the title of the company be altered to that of "North and South London Railway."

After some discussion, the resolution was carried in the form of a recommendation to the directors to consider the matter, which the chairman said the board would be happy to do.

Direct United States Cable Co., Ltd.

The report of the directors for the six months ended June 30th, 1910, shows that the half-year's revenue, after deducting outpayments, amounted to £58,556, as compared with £56,445 for the corresponding period of 1909, showing a difference of £2,111 in favour of the half-year under review. The working and other expenses for the same period, including income-tax, amounted to £25,277, leaving a balance of £33,279 as the net profit, making, with £6,859 brought forward from the previous half-year, a total of £40,138. For the corresponding period of 1909, the working expenses and other payments amounted to £25,036. Three quarterly interim dividends of 4s. each per share, amounting to £36,426, have been declared and paid during the financial year, and a final dividend of 4s. per share is proposed, together with a bonus of 2s. per share, both free of income-tax, making, with the three interim dividends, 4½ per cent. for the year, being a total distribution of £54,639. After transferring £5,000 to the reserve fund account, the balance of £4,783 on the revenue account is proposed to be carried forward. The reserve fund account has been debited with £3,584 for the cost of cable maintenance, and after being credited with interest on the investments, profit on sale of securities, and amount transferred from revenue, the balance now amounts to £533,024. The Hon. Thomas H. A. E. Cochrane and John Varley, Esq., directors, retire by rotation, and offer themselves for re-election.

The sixty-sixth ordinary general meeting of the shareholders of the above company was held on Tuesday, at Winchester House, Old Broad Street, Mr. E. M. Underdown, K.C., presiding.

The Chairman, in proposing the adoption of the above report, briefly recapitulated the particulars contained therein. Comparing the figures with the corresponding six months of 1909, the revenue showed an increase of £2,112. The working expenses at the stations were within £150 of the total for the corresponding half-year. The reserve account had been credited with £9,772; from interest on investments, £137 profit on sale of securities, and £5,000 transferred from profits. The amount debited for maintenance of cables during the six months was exceptionally small. They were fortunate not to have any serious interruption of their cable, and they had only had to spend £3,584, as compared with £13,857 for the half-year to June, 1909. It was always a gratifying thing to have no interruptions, but of course they could not assume that they would be without interruption from time to time. The balance at the reserve account stood at £533,024, as compared with £510,267 at this time last year, or an increase of £22,757 during the year. The investments representing that fund stood in the balance-sheet at £523,878, after allowing for the depreciation of £40,000 made three years ago on account of the market depreciation. It was satisfactory to be able to state that the market value of the securities on June 30th amounted to £533,856, or £10,000 in excess of the balance-sheet figures, showing that they were recovering to a certain extent, the loss they had provided against. Summarising the results for the complete year, the revenue amounted to £118,894, as compared with £112,780 in 1909, and the expenditure was £50,567, as against £50,400, leaving a balance of £68,327. They had paid in dividends £54,639, as compared with £51,603 in the previous year, and had placed £12,500 to reserve, as against £10,000. When he addressed the shareholders last year he informed them that they had in contemplation the shifting of the cable to a point in Newfoundland—Harbour Grace. Arrangements had been made for carrying that out, and they trusted that in the ensuing month it would be carried through. A good deal of negotiation had been necessary, in order to place the company in a position to carry this out. Mr. Fenn, their manager, was in Newfoundland, and on behalf of the company he had purchased land and buildings at Harbour Grace with a frontage to the sea, suitable for the landing of the cable, and those negotiations had been carried through on what the board considered advantageous terms. They had also acquired landing rights for the cable, and various concessions from the Government and the municipality, and a boat was now on its way to Newfoundland with the first consignment of cable and equipment for the new station. The total cost, including various improvements and repairs would come within £40,000. The amount would be charged against the reserve fund, which would bring down that fund to about £500,000. It was, in the opinion of the directors, necessary that they should keep the reserve fund at about that figure, and he trusted they would be able to give the shareholders satisfactory dividends and bonuses without altering the amount of that fund.

Sir J. Pender, Bart., seconded the motion.

Mr. Fry referred to statements in the Press as to negotiations which were said to be going on between a big American telegraph and telephone company and the pool companies on this side, and asked the chairman whether he could give them any information.

The Chairman said he did not allude to those so-called negotiations because he really had nothing to tell about them. Very long reports of all sorts of things which were stated to have taken place had appeared in the financial papers. Unofficial conversations had taken place with regard to the company referred to by Mr. Fry, which had an extensive organisation for the introduction and development of telephones in the United States. Their ally was the Western Union, which was an internal telegraph company. He knew nothing as to the alleged control of the American company—if control meant a large majority, he did not think it was so. Conversations of that kind published in the newspapers were not things they need trouble to discuss. The position, as he understood it, as regarded their company was that no negotiations properly so called had taken place; and seeing the strong position they were in with their good business and their satisfactory reserve fund, he thought that if any propositions were made which would in any way affect their entity, the position would need to be examined with the greatest care. He had looked into all the possibilities, and he asked the shareholders to leave the board to secure the position of the company, at the same time behaving in the most friendly way to any developments on the other side in the shape of telephones. They were most anxious if there was any development of communication either by telephone or telegraph, that they should through their own friends and representatives obtain a fair share of any advantages that were to be got. Nothing, however, could be done without the approval of that company, and before they did anything they must obtain the approval of the shareholders.

The report was adopted.

Lanarkshire Tramways Co.

THE directors report for the half-year ended June 30th, 1910, a revenue of £36,181, with expenses £20,599, leaving £15,582. Less contributions payable to local authorities, £825, interest on debentures, £608, plus balance brought forward, £1,329, there is a balance of £15,477, which is to be disposed of as to £9,432 in payment of a dividend at the rate of 5½ per cent. per annum for the half-year, carrying £6,045 to revenue new account. The traffic receipts show an increase of £4,058 over those for the corresponding period of last year. This increase is attributable to the improved trade conditions and the extensions to Uddingston and Newmains which were opened for public traffic in July, 1909. The expenses show an increase of £2,913. The directors will, as usual, provide for depreciation when the final accounts are made up at the end of the year. The dividend is to be paid on August 5th.

Half-year ended.	Miles open.	Passengers carried.	Traffic receipts.	Average fare.	Car-mileage.	No. of cars.
December 31st, 1908	17·00	6,462,785	£33,168	1·23d.	818,355	58
June 30th, 1909 ..	17·00	6,273,276	31,623	1·20d.	807,960	53
December 31st, 1909	21·28	6,896,172	35,887	1·25d.	936,238	60
June 30th, 1910 ..	21·28	6,926,878	35,681	1·23d.	890,689	60

Madras Electric Supply Corporation, Ltd.

THE fourth annual general meeting was held on Wednesday last week at Salisbury House, London Wall, Mr. Arthur M. H. Walrond presiding.

The CHAIRMAN, in proposing the adoption of the report (see ELECTRICAL REVIEW, page 105), after referring to the loss the company had sustained in the death of Sir Ralph Moor, one of the directors, said that the accounts were presented for the first time in the form required by the Indian Electricity Act, and they would, in consequence, always be laid before them in the same way in future. The capital account showed an expenditure up to the date of the report of £305,295. The revenue account showed a loss on working of £7,840. This, however, was only what might be expected under the abnormal conditions they were working under all last year. The contractors' workmen being constantly engaged in erecting and testing machinery, it was impossible to keep their cost within bounds. This state of affairs had now practically ceased, and he thought the board could to-day safely say they were actually working at a profit, and that they had now, barring accidents, entered into the profit earning stage. They had received £918 as interest on their investment in the tramways, which gave them a return of 5¼ per cent. on their money, which they might consider satisfactory. In his statement last year he had to call serious attention to the delay on the part of the contractors in carrying out the work entrusted to them. This delay had been a very serious matter to them, and he was of opinion that if they had been able to supply current from their main station at the time they were led to expect, when the company was formed, they would have been by now earning sufficient money to have paid at any rate a modest dividend. He felt sure they would realise the anxiety this delay had caused the board and the officials in Madras. At the end of last year matters became so serious that they instructed Messrs. Kennedy & Jenkin to make a report to them on the whole position in Madras. Mr. Jenkin, therefore, visited Madras for that purpose. On his return they discussed the whole position with their legal advisers, and, as a consequence, wrote a letter to the contractors with a definite claim for damages for delay and other matters in connection with the plant, which included the claim from the Tramway Co. These claims amounted to a very considerable sum of money. He did not think it necessary to go into all the details of these claims, and he was very pleased to say Messrs. Crompton & Co.—as one would expect a firm of their high reputation would do—met them at once in the best spirit possible, and, although admitting no legal liability, they acknowledged the loss and inconvenience they had suffered was very great, and said if it were possible to come to an agreement they would only be too glad to do so. The boards of both companies considered it would be of no advantage and cost a great deal of money to fight the issue out in the Courts. They had, therefore, agreed to compromise matters in a way that was, they believed, a settlement fair and reasonable to both parties; and while they did not for a moment say the company had received back all the damage it had sustained, still they had obtained besides a cash payment sundry modifications in the contract which, in their opinion, would give them advantages in the future of certainly equal value to the sum they claimed, and possibly more. They were satisfied that they had adopted a sensible course, and that this would be a satisfactory solution of a very complicated position. They now had a fresh start. The contract, with a few agreed modifications, was completed, and the plant was doing its work satisfactorily. There were some alterations in the grates and boilers to be done to bring them up to the specified efficiency, and this matter was being attended to, and would be carried out by the contractors. They had, however, sufficient experience of the plant to know the working costs were going to be economical. The tramway supply commenced on January 12th last, and they might imagine it was a great relief to them when they received the cable informing them the supply had commenced. The supply had been satisfactorily maintained ever since. They believed this large and steady load would be of considerable value to them in the future. The progress on the direct-current side to the ordinary consumer was very apparent. The Port Trust and Fort St. George were now being supplied, and they would before long have all the naval and military establishments on the mains. The demand by fresh customers week by week was most encouraging, and should, they considered, increase rapidly, as every customer who had their current must be a very good advertisement, especially in Madras, where the electric fan once seen became a necessity. The return up to date of lamps connected, irrespective of the tramways, was a good record for the first year's working. The following was a record of the progress up to date:—Supply commenced April 3rd, 1909; equivalent number of 8-C.P. lamps connected, 5,200; at June 26th, 1909, the number was 12,749, while at June 25th, 1910, the number had grown to 58,038, and 5,130 were awaiting connection. It was with great reluctance the board were obliged to exercise their power last January to convert the old debentures into ordinary shares, and they very much hoped, and were encouraged to believe, that these shares would not remain long without a dividend. In the meantime, as he foreshadowed in his statement last year, owing to the numerous extensions of mains required for the development of the business, as well as on account of the delay of the contract, it was now necessary to raise some further capital. They had, therefore, decided to offer to the shareholders a 6 per cent. debenture, which would be secured as a first charge on all the assets of the company, and which, as they considered they had reached the turning-point, should prove an excellent investment. It was decided to make this an attractive security and not to have it underwritten, so that whatever advantage there might be in it would belong to the shareholders themselves if they wished to avail themselves of the opportunity. He would like to conclude by summarising what the board considered the satisfactory features of the undertaking to-day:—(1) The contract was now practically completed, and they had settled their claim against the contractors. (2) The returns of lamps connected continued to grow, and were very satisfactory. (3) Their working costs were proving to be satisfactorily low, and they were now generating their current even with their present small output at a cost of under one penny per unit. (4) They could now say their revenue to-day exceeded their expenditure, and before the end of the year they should be more than earning their debenture interest. (5) They had plant erected capable of dealing with a much larger demand than they had at present, which would be gradually brought into use as the demand increased.

SIR W. J. CUNNINGHAM seconded the motion.

COL. FILGATE expressed satisfaction at the progress which the company had made since last year. It would appear, he said, that next year they would be supplying two million units per annum, and in addition to paying the debenture interest the company ought to be able to earn 5 per cent. upon the ordinary shares.

MR. F. COOK asked why the penalty clause was omitted from the contract. The omission was a very serious matter, as events had turned out.

The CHAIRMAN, in reply to questions, said that their agents in Madras were acting for the company in a very satisfactory manner, and they had no intention of discontinuing the present arrangement. The matter of appointing a consulting engineer would not be lost sight of by the board, but at present they were in the hands of the contractors. As to the penalty clause, at the time the company was formed, it was impossible to get such a clause inserted in the contract.

The report was adopted.

Anglo-American Telegraph Co., Ltd.—The directors report that the total receipts from January 1st to June 30th, 1910, including the balance of £1,894 brought forward from the last account, amounted to £208,950. The traffic receipts show an increase of £6,988, as compared with the half-year ended June 30th, 1909. The working expenses of the half-year, as shown by the revenue account, amounted to £75,652, being an increase of £3,307, as compared with the corresponding period of 1909. The directors have, before declaring the net profits, set apart the sum of £10,000 to the renewal fund, leaving a balance of £123,297. Quarterly interim dividends of 15s. per cent. on the ordinary stock, and £1 10s. per cent. on the preferred stock, were paid on April 30th, 1910, absorbing £52,500, and second quarterly interim dividends of 15s. per cent. on the ordinary stock, and £1 10s. per cent. on the preferred stock, amounting to £52,500, will be paid on July 30th, 1910. The balance of £18,297 will be carried forward.

Montreal Light, Heat and Power Co., Ltd.—The directors have declared a dividend of 1¾ per cent. on the paid-up capital stock (being at the rate of 7 per cent. per annum) for the quarter to 31st inst.

Kensington and Knightsbridge Electric Lighting Co., Ltd.—The directors have declared an interim dividend on the ordinary shares for the half-year ending June 30th, 1910, at the rate of 8 per cent. per annum, payable August 15th.

Bristol Tramways and Carriage Co., Ltd.—An interim dividend has been declared at the rate of 4 per cent. per annum for the half-year ended June 30th. Dividend warrants will be posted to-day.

National Telewriter Co., Ltd.—At the annual meeting on Monday last, Sir W. P. Treloar, who presided, said the first year's business had been disappointing, owing to delayed delivery of apparatus. Orders for upwards of 100 instruments had been obtained. The City Telewriter Exchange was opened on the 1st inst., and it was hoped that an arrangement would be come to for messages to be sent through the company's exchanges direct to the cable companies' offices. The report was agreed to.

New General Traction Co., Ltd.

THE report of the directors, presented at the fourteenth annual general meeting on July 26th, states that the revenue for the year, received and accrued from the various sub-companies, amounted to £19,482, against £18,701 in the previous year; general expenses, including directors' fees and legal charges, amounted to £1,792, as against £1,990 in 1908-9. The accounts for the year show a profit of £501, after providing for the realised loss of £376 on the sale of $64,000 4½ per cent. first mortgage bonds of the Darby, Media and Chester Street Railway Co., and £1,500 towards depreciation of investments, thus reducing the balance of loss previously shown to £25,306. The dividend received from the Coventry Electric Tramways Co. for the year ended December 31st, 1909, was the same as for the previous year, viz., 3½ per cent. The accounts of the Norwich system show that there was an increased profit. A dividend of 1¼ per cent. was received from that company for the year ended June 30th, 1909, against 1¼ per cent. for the previous year. The Douglas Southern Electric Tramways Co. paid 5 per cent. on its preference shares for the year 1909, as compared with 5½ per cent. for the preceding year. The income from the Philadelphia undertaking for the year amounted, under the terms of the lease, to £10,324. The director retiring in rotation was Mr. Francis Fitzgerald, who offered himself for re-election.

AT the annual meeting, BARON EMILE B. D'ERLANGER, chairman, in proposing the adoption of the above report, said that the total revenue for the year from their sub-companies was £780 in excess of that derived from the same sources in the previous 12 months. The dividend received from the Coventry company, after deduction of income-tax, provided them with £4,263. Their Norwich dividend was an increase of ½ per cent., and amounted to £3,188. The Douglas Tramways paid them a dividend amounting to £579, against £640 for the corresponding period. £10,324 was received from the Darley, Media and Chester Street Railway Co. for interest on the bonds, and dividend on the shares which they held in that undertaking, a decrease of £113 as compared with the previous year. The interest payable to them from Coventry accounted for £1,126, as against £1,149. Those figures aggregated together £19,482, as compared with £18,701 for the year 1908-9. A further saving had been made in general expenses amounting to £200, while interest on loans, discount and commission was less by £441. During the year they had disposed of $64,000 of bonds in the Darley, Media and Chester Street Railway Co., and the amount of £376, shown as a debit on that sale, represented the difference between the value of those bonds as shown in the balance-sheet, and the figure at which they were sold, viz., 95 per cent. They had written off £1,500 towards depreciation of investments, and after providing for that and for the realised loss on the bonds sold, the account showed a profit of £501, reducing the balance of loss previously shown to £25,306; £4,000 of the prior lien debentures were drawn and paid off on January 1st last, in accordance with the terms of the trust deed, thus reducing their liabilities under that head to £76,000. They had recently been able out of reserve sources to pay off another £5,000 of loans. With regard to their subsidiary companies, the Coventry system continued to give fairly satisfactory results. The dividends had been maintained, in addition to which £2,000 was placed to reserve for depreciation. The traffics at Coventry for the current year were showing satisfactory increases, and they had no reason to anticipate a falling-off in that direction. As to Norwich, although the revenue had decreased, the expenses had also considerably diminished, with the result that there was an increased profit for the year. He was glad to say that the financial year of the Norwich Co., which had just expired, showed an increase in the traffics. Against that, however, the permanent way maintenance had also increased, so he was afraid they could not look for an increased dividend. At Douglas, owing to the exceptionally bad weather last summer, there was a slight decrease in the receipts. With regard to the Philadelphia undertaking, although there was a serious strike among the tramway employés last year, the Rapid Transit Co. had fulfilled their obligations to the company, and he was glad to say that the business of the tramways in that city was now pursuing its normal course.

MR. E. A. HOPKINS seconded the resolution, which, after a short discussion, was adopted.

North Melbourne Electric Tramways and Lighting Co., Ltd.—The report states that the operation of the company's undertaking still continues under the management of Messrs. J. G. White & Co. According to the *Financier* the net revenue shows a slight increase in both the lighting and tramway business, but the results, the directors regret to report, are not as satisfactory as they had hoped. The company is gradually extending its lighting and its supply business, and the directors believe the improvement in this department will continue. The meeting was held at Cloak Lane, E.C., last Friday.

Mexico Tramways Co.—It is stated that the accounts for 1909 show a net revenue of $922,500, and dividends at the rate of 6 per cent. per annum have been paid.

Central London Railway Co.—The directors recommend for the half-year ended June 30th a dividend of 3 per cent. per annum on the ordinary, and 4 per cent. per annum on the preferred shares. Provision is also made for the dividend on the deferred, payable at the end of the year, and £40,000 is carried forward.

Metropolitan Railway Co.

THE directors report that the total receipts for the half-year ending June 30th, 1910, amount to £391,488 and the expenses to £194,020, leaving a profit of £197,468. Compared with the corresponding half-year of 1909, the receipts show an increase of £12,001, and the expenses an increase of £777. The net revenue account, after providing for the interest upon the debenture stocks and other fixed charges, and placing £10,000 to the electrical renewal and depreciation fund, shows a balance of £146,380, which will permit of the payment of the dividends upon the preference stocks, and leave a balance of £41,869 available for dividend upon the ordinary stock. The directors recommend the proprietors to declare a dividend upon the ordinary stock, for the past half-year, at the rate of £1 5s. per cent. per annum, and to carry forward the balance of £6,044 to the next half-year's accounts. The Surplus Lands Committee announce that the dividend on the surplus lands stock, for the past half-year, will be at the rate of £2 15s. per cent. per annum. The passenger traffic continues to exhibit satisfactory progress. An important factor in this development is undoubtedly the through train service between the City and stations on the Aylesbury and Uxbridge extensions, which is being increased to meet the requirements of the traffic. The earnings from goods traffic continue to improve, largely due to the fact that the company now possesses its own depôt in London. The Japan-British Exhibition at Wood Lane was opened on May 14th, and is being well patronised, the traffic derived therefrom being largely in excess of that obtained from the Imperial International Exhibition held on the same site last year. There is every likelihood that the attractions of the present exhibition will result in a large number of passengers being conveyed over this company's railway during the approaching holiday season. The Bill promoted by the company in the present session of Parliament has passed both Houses, and is now awaiting the Royal Assent. The Bill promoted by the Metropolitan District Railway Co. was opposed on behalf of the Hammersmith and City Joint Committee by this company and the Great Western Railway Co., but an agreement has been arrived at with the promoters for the insertion of a clause in the Bill to protect the interests of the Committee. A contract has been let for the installation of automatic signalling on the section of the line between Baker Street and Neasden, and the work is now in progress. The Metropolitan District Railway Co., in the exercise of the powers granted to them by the Harrow and Uxbridge Railway Act, 1899, inaugurated the running of a through service of trains between their stations and Uxbridge on March 1st, and this additional service will materially assist in the development of traffic over this company's Uxbridge branch. By arrangement with the Pullman Co., Ltd., Pullman cars commenced to run on certain of the through trains between the Aylesbury extension line and the City on June 1st. The patronage which the cars have already received shows that the additional facility thus afforded is highly appreciated by the public. An agreement has been entered into with the London County Council for the erection by the company of a bridge over the railway at King's Cross Station; and in conjunction therewith, a reconstruction of that station will be carried out. These works are already in progress. Plans for the construction of an arcade over the railway at Liverpool Street Station have been approved, and the work has been commenced. It is anticipated that a substantial rental will accrue from the shops which will be erected. The progress of the traffic carried has been as follows:—

Year.	Number of passengers.	Gross receipts for passengers, goods, minerals and tolls.
1907	96,859,108 ..	£640,388
1908	99,846,735 ..	680,357
1909	99,961,997 ..	696,881
1910 (to June 30th)	50,808,493 ..	353,419

The dividends will be payable on August 6th.

Stock Exchange Notices.—Applications have been made to the Committee (1) to appoint a special settling day in and to grant a quotation to:—

Electric Light and Power Co. of Cochabamba.—Scrip, fully and partly paid, for £300,000 6 per cent. Government guaranteed loan.

And to allow the following to be quoted in the Official List:—

British Columbia Electric Railway Co., Ltd.—Further issue of £550,000 4½ per cent. perpetual consolidated debenture stock.

Tungsten Lamps.—The Wolfram Lamp Co., of Augsburg, reports profits of £11,800 for 1909-10, of which £9,690 has been devoted to depreciation, £2,000 placed to reserve fund for claims, and the balance carried forward. These results, after placing £10,100 to depreciation, compare with a loss of £10,100 in 1908-9, the company not having paid any dividend since its formation.

Rees-Roturbo Development Syndicate.—The directors report that during the six months ended June 30th, 1910, the increase in the sales of machinery under the patents owned by the syndicate has been very satisfactory; they have decided to pay an interim dividend, as before, at the rate of 5 per cent. per annum, which, less income-tax, will absorb £706.

Bayliss, Jones & Bayliss, Ltd.—The directors have decided not to pay any interim dividend on the preference shares at present.

City of Buenos Ayres Tramways.—A dividend of 1s. 3d. per share, less tax, has been declared, for the three months ended June 30th.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £*		No. of wks.	Total to date. £	£*	Route miles open. Inc.
Aberdeen	July 20	3,135	— 210	7	10,746	— 88	.. ..
Ayr	„ 23	1,447	+ 104	10	4,015	+ 210	8 ..
Bath	„ 23	1,824	— 154	29	22,548	+ 1,274	.. ..
†Belfast	„ 15	4,806	+ 291	15	61,427	+ 2,433	37 ..
Birkenhead	„ 24	2,250	+ 73	16	18,132	+ 321	13·68 ..
Birmingham Corp.	„ 16	13,498	—1,900	15	103,127	— 800	56·46 ..
Blackburn	„ 20	2,316	+ 174	16⅔	18,338	+ 841	14·62 ·12
Blackpool Corp.	„ 21	3,816	+ 514	..	17,091	— 1,460	.. ..
†Blackpool-Fleetw'd	„ 23	1,473	+ 111	..	3,769	+ 103	.. ..
Bolton	„ 24	4,966	+ 281	17	39,231	— 549	26 ..
Bournemouth	„ 20	7,143	+3,803	15⅔	30,373	+ 3,801	21·96 ..
†Bradford	„ 23	5,484	+ 460	17	84,903	+ 2,569	54·81 ..
Brighton	„ 24	2,095	+ 29	16⅔	15,494	..	9·45 ..
Bristol	„ 22	12,433	+ 660	..	..	..	.. ..
Brit. Elec. Trac. Co.							
Airdrie	„ 15	465	+ 10	28	6,155	+ 118	3·65 ..
Barnsley	„ 15	325	— 1	28	4,759	+ 140	.. ..
Barrow	„ 15	654	+ 137	28	7,148	+ 1,013	5·37 ..
Cavehill	„ 15	453	+ 47	28	2,525	+ 221	.. ..
Devonport	„ 15	822	+ 106	28	11,539	+ 1,432	8·85 ..
Gateshead	„ 15	2,007	— 7	28	27,265	— 240	11·25 ..
Gravesend	„ 15	452	— 18	28	5,591	+ 98	6·5 ..
Greenock	„ 15	1,505	+ 482	28	17,032	+ 2,550	7·25 ..
Hartlepool	„ 15	571	+ 15	28	6,471	+ 303	6·72 ..
Kidderminster	„ 15	289	..	28	2,818	+ 76	.. ..
Leamington	„ 15	369	— 51	28	4,406	— 153	.. ..
Merthyr	„ 15	471	+ 5	28	5,684	— 198	2·9 ..
Metropolitan	„ 15	15,668	+1,926	28	204,006	+37,660	22 ..
Middleton	„ 15	721	— 7	28	8,668	— 550	8·5 ..
Mid. Joint Com'tee	„ 15	11,573	—2,022	28	158,101	+ 1,395	.. ..
Oldham—Ashton	„ 15	1,262	— 7	28	14,349	— 68	9·13 ..
Peterborough	„ 15	348	— 24	28	3,114	— 33	5·31 ..
Potteries	„ 15	3,536	— 71	28	48,750	— 497	29 ..
Rothesay	„ 15	1,036	+ 203	28	4,266	+ 173	2·75 ..
Southport	„ 15	727	+ 19	28	7,854	+ 236	8·17 ..
S. Metropolitan	„ 15	1,763	+ 19	28	22,438	+ 1,279	.. ..
Swansea	„ 15	2,314	+ 284	28	29,205	+ 3,458	12·5 ..
Tynemouth	„ 15	710	— 61	28	6,117	+ 523	3·75 ..
Weston-s-Mare	„ 15	667	+ 112	28	2,878	+ 90	3 ..
‡Worcester	„ 15	740	+ 6	28	7,516	+ 179	5·75 ..
Wrexham	„ 15	197	— 2	28	2,672	+ 17	.. ..
Yorks. Wool. Dist.	„ 15	2,009	+ 186	28	27,073	+ 2,465	17 ..
Miscellaneous	„ 1	522	+ 77	26	5,233	+ 379	.. ..
Burnley	„ 23	2,572	+ 111	..	..	..	.. ..
Burton-on-Trent	„ 24	552	— 1	16	4,375	— 41	6·75 ..
†Bury	„ 17	1,242	+ 49	15⅔	18,415	— 449	22·5 ..
Cardiff	„ 16	4,942	— 6	16	34,612	+ 703	.. ..
Carlisle	..	..	..	..	..	..	.. ..
Chatham and Dist.	„ 21	1,700	— 188	29	23,551	+ 907	14·98 ..
Cork	„ 21	1,134	+ 16	29	13,914	+ 1,668	9·89 ..
Croydon	..	..	..	..	..	..	.. ..
Darlington	„ 23	416	+ 43	17	3,396	+ 165	.. ..
Darwen	„ 22	509	+ 11	16	4,026	— 141	4·36 ..
Dover	„ 16	479	+ 23	15	3,188	+ 20	4·75 ..
Dublin	„ 22	13,286	+ 168	..	18,792	+ 574	54·25 ..
Dundee	„ 20	2,446	+ 95	9⅔	11,576	+ 263	15·5 ..
East Ham	„ 23	2,100	— 93	16⅔	17,010	+ 218	8·52 ..
Exeter	„ 22	723	— 37	16	5,237	— 634	5·5 ..
†Glasgow	„ 16	18,392	+1,431	..	123,236	+ 488	97·25 2·75
Hastings	„ 21	2,293	— 27	..	..	..	.. ..
Huddersfield	„ 23	3,644	+ 421	16	28,754	+ 1,509	28·5 ·5
Hull	„ 23	5,430	+ 430	16	43,835	+ 2,837	14·5 1·5
†Ilkeston	„ 13	133	— 2	15	1,915	— 93	.. ..
†Ipswich	„ 16	475	+ 16	15	6,251	+ 201	10·5 ..
Kilmarnock	„ 16	318	+ 12	9	1,359	+ 18	4·25 ..
Lancashire United	„ 20	2,797	+ 109	29	37,401	— 447	39 ..
Leeds	„ 16	14,372	+ 215	16	108,399	+ 3,347	.. ..
Leicester	..	..	..	..	..	..	.. ..
Leith	„ 23	1,400	— 3	9⅔	6,512	+ 179	8·724 2
Liverpool	„ 16	23,327	+ 562	28	310,395	+11,926	113·5 6
‡L.C.C.	„ 13	85,396	+12,357	..	628,286	+91,042	133 13·5
London United	„ 23	13,905	— 150	..	180,876	+ 9,870	.. ..
Lowestoft	..	..	..	..	..	..	.. ..
Manchester	„ 23	31,531	+1,481	16	253,629	+ 4,549	183 1
Newcastle	„ 23	8,096	+ 549	..	66,429	+ 151	14·5 ..
Newport	„ 16	1,399	+ 86	16	10,951	+ 399	14·5 ..
Oldham	„ 24	3,807	+ 68	17	32,317	— 941	23·75 ..
Pontypridd	..	..	..	..	..	..	.. ..
†Portsmouth	„ 16	2,288	+ 81	15	31,130	— 1,040	14·5 .75
Preston	„ 13	763	+ 15	15	11,003	— 278	.. ..
Rotherham	..	..	..	..	..	..	.. ..
†Salford	„ 18	4,802	+ 199	15⅔	73,273	+ 256	.. ..
Sheffield	„ 26	11,895	+ 614	17⅔	103,471	+ 5,830	39·8 ·8
Southampton	„ 20	2,293	+ 30	..	..	..	.. ..
Southend-on-Sea	„ 20	1,437	— 144	16	8,963	+ 673	.. ..
South Shields	„ 23	1,199	— 20	16⅔	9,169	— 88	.. ..
Swindon	„ 13	256	+ 2	..	..	..	.. ..
Tyneside	„ 20	1,032	+ 72	3	1,411	— 9	.. ..
Wallasey	„ 16	2,184	+ 61	15⅔	14,381	— 361	.. ..
Walthamstow	„ 23	1,508	+ 107	16	11,928	+ 706	9 ..
West Ham	„ 14	5,089	+ 261	15	37,285	+ 1,497	15·25 ..
Wolverhampton	„ 21	2,062	+ 311	16	15,194	+ 2,033	14·5 2
Baker St.-Waterloo	„ 23	6,320	+ 150	3	9,970	+ 235	4·25 ..
Cen. London Rly.	„ 23	11,315	+ 594	3	17,341	+ 1,012	6·32 ..
Char.+Ems. Hamp.	„ 23	7,205	— 625	3	10,915	— 905	7·75 ..
City & S. Lon. Rly.	„ 24	6,129	+ 52	3	9,254	— 14	7·26 ..
Dublin-Lucan Rly.	„ 22	360	+ 42	3	523	+ 17	7 ..
G.N. and City Rly.	„ 23	2,629	+ 36	3	3,980	+ 51	3·5 ..
G.N., P'dy. & Brmp.	„ 23	10,865	+ 105	3	16,765	+ 330	9·25 ..
L'pool Overh'd Rly.	„ 24	2,879	+ 35	..	5,750	— 76	6·8 4·8
†Llandudno-Col. Bay	„ 15	463	+ 52	39½	6,448	+ 1	.. ..
Mersey Railway	„ 23	3,953	+ 80	3	5,886	+ 20	4·5 ..
Metropolitan Rly.	„ 24	34,188	+ 609	..	51,816	+ 1,138	24·5 ..
Met. District Rly.	„ 23	21,441	+ 431	3	32,662	+ 1,311	24 ..
Anglo-Argentine	„ 22	86,759	+13,119	..	1,280,878	+148,022	.. ..
§Auckland	June	15,046	+ 833	24	88,975	+ 5,674	23 ·7
Bombay (B.E.T.)	July 24	5,295	+ 304	25	68,220	+ 4,672	.. ..
§Brisbane	June	17,720	+2,240	26	104,730	+12,043	.. ..
§Brit. Columbia Rly.	..	..	..	..	..	..	.. ..
Calcutta	July 23	8,004	+ 245	..	..	..	.. ..
§Cape Electric T.Ld.	..	..	..	..	..	..	.. ..
§Kalgoorlie, W.A.	June	3,608	..	..	20,571	..	20·5 ..
Madras	July 15	1,805	— 30	..	17,490	+ 1,111	.. ..
Montevideo	June	20,976	+2,490	24	122,748	+16,741	.. ..
§Lisbon	..	..	..	..	..	..	.. ..
†Perth (W.A.)	July 15	1,593	+ 149	..	43,273	+ 3,971	29 1

* Compared with the corresponding period of 1909. † One week only.
‡ Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES.

Tuesday Evening.

MOST of the markets round the Stock Exchange are in about as miserable a condition as can well be imagined. Short of a state of panic, or semi-panic, the depression is more wretched than anything else, and business is curtailed by the incessant liquidation emanating from the Continent as well as from the States.

In such circumstances, the hapless writer of financial facts, &c., feels very much inclined to cut the column extremely short, and look up excursion trains going to places far off. This temptation, however, is the easier to resist, in that the Electricity markets are by no means bad, and that there are even a few rises to be found by close examination of the succeeding pages of quotations.

The Home Railway market is perhaps the most hopeless of all the Stock Exchange sections at present. Dividend declarations made so far are moderately good, but the labour troubles on several of the principal lines have led to a general marking down of quotations.

On Monday in this week the London Brighton Railway Company declared a dividend on its Ordinary stock at the rate of 3 per cent., which is ¼ per cent. more than the rate paid a year ago. The market, however, had expected at least 3¼ per cent., if not 3½ per cent., because of the traffic increase, supposed to have been due largely to the success of the electrified portion of the line. The disappointment caused a sudden fall in the price of the Deferred stock, and added a new gloom to the market as a whole.

Metropolitan Consolidated has fallen still further, and Districts are particularly flat at 20½, a drop of 1¼. The Tube stocks are practically unchanged.

The electricity supply market shows the remarkable record of three rises and no falls. "City Lights" have climbed ¼ further Edmundson's Debenture has recovered a point of its dividend, and Mexican Electric Light 5 per cent. gold bonds are ¼ higher. It might be urged by the cynical or the flippant that these advances are not imposing, but the mere fact of their being here at all, in such times as the present, ought to serve as encouragement to long-suffering proprietors of electricity supply shares. Nevertheless, the reduction from 5 per cent. to 4 per cent. in the interim dividend on Metropolitan Electricity Ordinary shares is disconcerting.

An interesting promotion of the week has been a prospectus of Metalite, Ltd., out of whose nominal capital of half a million sterling, £380,000 in £1 shares formed the current issue. The object of the company is mainly to manufacture a special kind of metal-filament lamp, called the "British Metalite," and the shares are not suited for investment of the widow's and the orphan's money. Estimates of profits to be made are very rosy, and in the meantime the company seems to be paying stiffly for underwriting, as well as for the assets.

Anglo-American Telegraph stocks are down again, the Deferred being most affected. Great Northerns continue to dwindle. On the other hand, the Eastern group keeps very steady, and Globe Telegraph Ordinary are ¼ up. United River Plate Telephone fell back, and the National Telephone series has hardly moved.

There is a rise of 2 in British Westinghouse 4 per cent. Debenture stock, and British Insulated show a 5s. rise. Telegraph Constructions came in for inquiry, and a small buying order raised the price by 15s. Underground Electric Railway prior lien bonds have improved, and this, in spite of the weakness in Districts and other Home Railway issues. In the traction group there is not much going on. Mexico Trams and British Columbia Deferred are duller, and these are the only issues that have moved.

Electric Railways.—In a paper read before the Central Club, at Buffalo, on May 13th, Mr. Frederick Darlington stated that estimates recently prepared for the electrification of about 100 miles of single-track railroad, with about 25 miles of side tracks and with heavy grades to be climbed and very heavy and frequent trains to be handled, show the total cost of direct-current transmission and distribution apparatus, including sub-stations, to be $2,381,000, and for single-phase alternating current with transformer stations $1,011,000. This was figured for 1,500 volts on a third rail for direct current and 11,000 volts on an overhead trolley for single-phase current. The difference in cost of the two distribution systems is $1,370,000. The single-phase locomotives for the same railroad would be more costly than direct-current locomotives by about $374,500, but this amount is only about one-quarter of the difference in the cost of the transmission and distribution appliances —*Electrical World*.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations July 17th.	Closing Quotations July 26th.	Business done week ended July 26th, 1910.		Rise + or Fall —	Present Yield per cent.
		*	1906.	1907.	1908.	1909.			Highest	Lowest.		£ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	Nil	3⅜— 3⅞	3⅜— 3¼	..	..	..	Nil.
286,500	Do. 5 % Deb. Red. Iss. at 98 % script all paid	Stock	5 %	5 %	5 %	5 %	.. ..	95 — 97	..	..	..	4 17 7
$255,196,000	American Telephone & Telegraph, Cap Stock ..	$100	8 %	8 %	8 %	8 %	136 —138	136 —138	136½	..	..	5 15 11
$53,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 53,001 to 78,000	$1000	4 %	4 %	4 %	4 %	91 — 93	91 — 93	..	..	..	4 6 0
558,460	Anglo-American Telegraph	Stock	3⅞%	3⅞%	£3 4s.	3⅞%	64 — 66	63½—65½	63⅞	..	— ⅛	5 10 8
3,220,770	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	6 %	106½—108½	106 —108	107⅞	106	— ⅛	5 11 1
3,220,770	Do. do. do. Deferred	Stock	1⅜%	1 %	8/-	25/-	25½—25⅝	24½— 25	25⅛	24⅞	— ⅛	5 0 0
47,725	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	5 %	5 %	5 %	5 %	100 —102	100 —102	..	..	..	4 18 0
44,000	Chili Telephone, Nos. 1 to 44,000	5	8 %	8 %	8 %	8 %	8½— 9⅛	9 — 9⅜	..	..	+ ⅛	4 4 3
2,449,176	Commercial Cable, Stlng. 500 year 4% Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	83 — 85	83½— 85½	85½	83½	+ ½	4 13 7
16,000	Cuba Telegraph	10	5 %	6 %	6 %	6 %	8½— 9	8⅜— 9	..	..	..	6 13 4
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	10 %	16½— 17½	16½— 17½	17	..	..	5 15 11
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3⅛— 3⅜	3⅛— 3⅜	..	..	..	5 3 3
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 %	7⅞— 8½	7⅞— 8½	..	..	..	6 1 3
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..	4 9 1
60,710‡	Direct United States Cable	20	4½%	4½%	4½%	4 %	14½— 15	14½— 15	14½	..	..	5 6 8
36,000	Direct W. India Cable, 4½% Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4 %	4½%	98 —100	98 —100	..	..	..	4 10 0
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	132 —135 xd	132 —135	134	132	..	5 3 8
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	3½%	3½%	83 — 85 xd	83 — 85	84¼	84¼	..	4 2 4
1,896,706	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	102 —104	102 — 104	..	..	..	3 16 11
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	12⅜— 12⅝ xd	12⅜—12⅝	12⅜	12⅛	..	5 8 9
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	101 —103	101 —103	102⅜	..	..	3 17 8
200,000‡	East. & S. Afric. Tel., 4 % Mt. Db. Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	99½—101½	99½—101½	99½	..	..	3 18 10
181,127	Globe Telegraph and Trust	10	5⅛%	5⅛%	5⅛%	5⅛%	10½— 10⅝	10½— 10⅝	10⅝	10⅛	..	5 10 3
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	12¼— 13⅜	13 — 13⅜	13⅜	13¼	+ ⅛	4 8 11
150,000	Great Northern Telegraph, of Copenhagen.. ..	10	20 %	20 %	18 %	..	30 — 31	29½— 30½	30	29½	— ¼	6 3 0
17,000	Indo-European Telegraph	25	13 %	13 %	13 %	13 %	53 — 55	53 — 55	54½	54¼	..	6 15 8
£41,380,400	Mackay Companies Common	$100	3½%	4 %	4 %	4⅛%	86 — 90	86 — 90	..	..	..	4 14 5
$50,000,000	Do. do. 4% Cum. Pref.	$100	4 %	4 %	4 %	4 %	76 — 80	76 — 80	74½	..	..	5 0 0
394,190	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	1/16— 1/32	1/16— 1/32	..	..	..	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	6 %	6 %	6 %	6 %	⅞— 1	⅞— 1	..	..	..	6 0 0
86,492	Do. do. do. 5 % Pref.	1	5 %	5 %	5 %	5 %	1/16— 1/32	3/32— 3/32	..	..	+ 3/32	6 3 1
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	106½—108	106½—108	107⅜	106⅝	..	5 11 1
3,725,000	Do. do. Def. Stock	100	5 %	6 %	6 %	6 %	126½—128½	126½—128⅝	127¼	126½	..	4 13 5
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	10⅜— 10⅝	10⅜— 10⅝	10⅜	10⅛	..	5 10 4
15,000	Do. do. 6 % Cum. 2nd Pref.	10	5 %	6 %	6 %	6 %	10⅜— 10⅝	10⅜— 10⅝	..	..	..	5 10 4
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5 7/16— 5 1/2	5 7/16— 5 1/2	5 17/32	5 7/16	..	4 7 11
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	96 — 98	96 — 98	97	96½	..	3 11 5
1,983,598	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	98 —100	98 —100	99⅜	..	..	4 0 0
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid..	1	7 %	8 %	8 %	8 %	1 7/16— 1 1/2	1 7/16— 1 1/2	..	..	..	4 14 10
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1 5/16— 1 7/16	1 5/16— 1 7/16	..	..	..	4 14 9
195,955	Do. do. do. 4 % Red. Deb. Stock..	100	4 %	4 %	4 %	4 %	86 — 88	86 — 88	86	..	..	4 10 11
99,400	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	96 — 98	96 — 98	..	..	..	4 1 8
11,839	Reuter's	8	5 %	5 %	5 %	5 %	7⅞— 8	7⅞— 8	..	..	..	4 18 9
145,955	Telephone Co. of Egypt, 4½ % Deb. Red.	100	4½%	4½%	4½%	4½%	98 —100	98 —100	..	..	..	4 10 0
3,042	Submarine Cables Trust..	Cert.	6 %	6 %	6 %	..	128 —131	128 —131	..	..	..	4 11 7
120,000	United River Plate Telephone	5	8 %	8 %	8 %	8 %	7⅜— 7⅝	6⅞— 7⅛	7 1/16	7 1/16	— ⅛	5 12 3
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5 1/16— 5 5/16	5 1/16— 5 5/16	..	..	..	4 15 3
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2½	2½%	2½%	2½%	..	1⅛— 1⅜	1⅛— 1⅜	..	..	..	4 10 11
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	96 — 98	96 — 98	..	..	..	4 1 8
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	7 %	13⅝— 14⅛	13⅝— 14⅛	..	..	..	4 19 1
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	99 —101	99 —101	100⅞	..	..	3 19 3
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	⅜— ¾	⅜— ¾	..	..	..	Nil
34,563	Do. do. 6 % Cum. 1st Pref.	10	8 %	6 %	6 %	6 %	8½— 9	8½— 9	8⅝	..	..	6 13 4
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	£2 6	15 %	14½%	8 — 9	8 — 9	8½	..	..	16 12 9
80,000‡	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	99 —101	99 —101	..	..	..	4 19 0

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

640,000	Anglo-Argentine Trams, 5% Cum. 1st Pref. 1 to 640,000	5	..	..	..	5 %	4 5/16— 4 3/8	4 5/16— 4 5/16	89/4½	87/6	..	5 9 7
500,000	Do. 5 % 2nd Pref., 800,000 to 1,300,000	5	..	..	..	5 %	4 3/8— 4 7/16	4 3/8— 4 7/16	86/3	83/9	..	5 12 8
4,465,674	Do. 4 % Deb. Stock	Stock	..	..	4 %	4 %	90 — 91½	90 — 91½	91⅛	90½	..	4 7 5
332,387	Auckland E. Trams, 5 % 1st Mort Deb. Stock ..	100	5 %	5 %	5 %	5 %	103 —105	103 —105	..	..	..	4 15 3
530,000	Babcock & Wilcox, 1 to 530,000	1	20 %	20 %	20 %	24 %	5⅜— 5⅝	5⅛— 5⅜	..	..	— 1/8	4 7 8
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1 1/16— 1 1/8	1 1/16— 1 1/16	..	..	..	3 19 0
1,000,000	British Aluminium 5 % Mort. Debs. Red.	100	..	..	..	..	.. ..	.. ..	..	..	..	5 10 0
500,000	British Columbia E. Rail Def. Ord. Stock ..	100	6 %	8 %	8 %	8 %	141 —146	140 —145	..	..	—1	5 10 4
400,000	Do. Pref. Ord. Stock	100	5 %	5 %	6 %	6 %	124 —128	124 —128	127½	126	..	4 13 9
400,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	108 —110xd	108 —111	108½	..	+ ½	4 10 1
233,000	Do. 4½ % 1st Mort. Deb., 1 to 6,250	40	4½%	4½%	4½%	4½%	102 —104	102 —104	..	..	..	4 6 7
212,600	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	100 —103xd	100 —103	..	..	..	4 7 5
133,301	British Electric Traction	10	Nil	Nil	Nil	Nil	⅜— 1	⅜— 1	12 6	..	..	Nil
161,437	Do. do. 6 % Cum. Pref.	10	6 %	3 %	1½%	Nil	2⅝— 3⅛	2⅝— 3⅛	59/4½	55 -	..	Nil
1,473,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	87 — 91	87 — 91	89	..	..	5 9 11
528,936	Do. do. 4½ % 2nd Deb. Stock Red.	100	4½%	4½%	4½%	4½%	68 — 73	68 — 73	..	..	..	6 3 3
100,000	British Insulated and Helsby Cables	5	10 %	10 %	10 %	10 %	6½ — 7	6¼ — 7	..	..	..	7 2 10
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅝— 6¼	6 — 6⅓	6¼	..	+ ¼	4 12 4
500,000	Do. do. 4 % 1st Mort. Deb. Red..	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
204,940‡	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 75,000	5	Nil	Nil	Nil	Nil	1/16— 2/16	1/16— 2/16	..	..	..	Nil
1,316,353	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	59 — 61	61 — 63	62½	60	+2	6 7 0
50,000	Browett, Lindley & Co., Ord.	1	Nil	Nil	Nil	Nil	1/16— 1/8	1/16— 1/8	..	..	..	Nil
50,000	Do. do. 6 % Cum. Pref.	1	Nil	Nil	Nil	Nil	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
140,976	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	Nil	0 — ⅛	0 — ⅛	..	..	..	Nil
200,000	Do. do. Non-cum. 6 % Pref.. ..	2	Nil	Nil	Nil	Nil	0 — ⅛	0 — ⅛	..	..	..	Nil
125,000‡	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	39 — 44	39 — 44	..	..	..	10 4 6
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock..	Stock	4½%	4½%	4½%	4½%	23 — 27	23 — 27	..	..	..	16 13 3
137,610	Calcutta Trams, 1 to 137,610	5	8 %	6 %	4½%	4½%	4 — 4½	4 — 4½	81/3	..	..	5 0 0
45,304	Do. 5 % Cum. Pref., Nos. 1 to 29,330..	5	5 %	5 %	5 %	5 %	4⅜— 4½	4⅜— 4½	25	4½	..	5 1 3
350,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	96 — 99	96 — 99	97/6	..	..	4 10 11
35,000	Callender's Cable Construction shares	5	15 %	15 %	15 %	10 %	9 — 10½	9½— 10½	9⅝	..	..	4 17 7
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	4⅝— 5⅛	4⅝— 5⅛	5⅛	5 1/16	..	4 15 3
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	100⅜—102½	100⅜—102½	..	..	..	4 7 10
491,222	Cape E. Trams., 1 to 491,222	1	Nil	Nil	Nil	..	2/32— 3/32	2/32— 3/32	..	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	8 %	12 %	12½%	12½%	2⅝— 2⅞	2⅝— 2⅞	54/3	52 6	..	4 10 11
210,153	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4 %	4 %	4½%	106 —109	106 —109	..	..	..	4 2 9
1,890,690	Central London Railway, Ord. Stock	Stock	4 %	3 %	3½%	3 %	66 — 68	66 — 68	67½	66¼	..	4 8 3
554,655	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	86 — 88	86 — 88	..	..	..	4 10 12
554,655	Do. do. Def. do.	Stock	4 %	2 %	2½%	2 %	49 — 51	49 — 51	..	..	..	3 18 5
1,480,000	City and South London Railway	Stock	2⅜%	2⅜%	1⅛%	1⅜%	28 — 29	28 — 29	29	28⅜	..	6 0 8
85,000	Crompton & Co., Nos. 1 to 85,000	8	5 %	5 %	Nil	Nil	⅛— ¼	⅛— ¼	..	..	..	Nil
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 900 of £100, and 901 11,000 of £50 Red	..	5 %	5 %	5 %	5 %	84 — 87	84— 87	..	..	..	5 14 11

* Unless otherwise stated, all shares are fully paid. ‡ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued.*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1906.	1907.	1908.	1909.	Closing Quotations July 18th.	Closing Quotations July 26th.	Business done week ended July 25th, 1910. Highest	Lowest	Rise + or Fall —	Present Yield per cent. £ s. d.
260,000	Dick, Kerr & Co., 1 to 260,000	1	10 %	10 %	6 %	6 %	1 1/16 — 1 3/16	1 1/16 — 1 3/16	22/9	..	..	5 1 1
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	6 %	1 — 1 1/8	1 — 1 1/8	..	..	..	5 6 8
271,030	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
60,000	Dublin United Trams. (1896), 6 % Pref., 1 to 60,000	10	6 %	6 %	6 %	6 %	13 — 14	13 — 14	..	..	..	4 7 3
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	5	4½%	2½%	Nil	Nil	1/16 — 3/16	1/16 — 3/16	..	..	..	Nil
17,139	Do. "A" shares, 01—017,139	5	4½%	2½%	Nil	Nil	1 — 1 1/8	1 — 1 1/8	..	..	..	Nil
307,895	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	63 — 68	63 — 68	..	..	..	5 17 8
67,720	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	79 — 82	79 — 82	..	..	..	6 1 11
112,100	Electric Construction, 1 to 112,100	2	Nil	Nil	Nil	Nil	1/8 — 3/16	1/8 — 3/16	..	..	..	Nil
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	7 %	1 1/8 — 1 1/4	1 1/8 — 1 1/4	..	..	..	8 12 4
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	..	7 1/2 — 8	7 1/2 — 8	..	..	..	6 5 0
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	82 — 86	82 — 86	..	..	..	4 13 0
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	4 %	2½%	Nil	Nil	3/4 — 1	3/4 — 1	..	..	..	Nil
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	..	..	10 1/2 — 10 3/4	10 1/2 — 10 3/4	..	..	..	6 10 3
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	..	102 —103 1/2	102 —108 1/2	..	..	..	4 16 10
40,000	Henley's (W.T.), Telegraph Works, Ord.	5	15 %	15 %	15 %	15 %	11 3/4 — 12 1/4	11 3/4 — 12 1/4	12 1/2	11 7/8	..	6 3 8
40,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	4 3/4 — 5 1/4	4 3/4 — 5 1/4	..	..	..	4 5 9
150,000	Do. do. 4½ % Mort. Deb Stock	Stock	4½%	4½%	4½%	4½%	103 1/2 —105 1/2	103 —105 1/2	..	..	..	4 5 4
50,000	India-Rubber, Gutta-percha & Telegraph Works	10	10 %	10 %	10 %	10 %	14 1/2 — 15 1/4	14 1/2 — 15 1/4	15	14 1/2	..	6 11 2
37,500	†Liverpool Overhead Railway, Ord.	10	Nil	1/2%	Nil	Nil	3/4 — 1	1 1/16 — 1 1/8	..	..	— 1/16	Nil
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	5 — 5 1/2	5 — 5 1/2	..	..	..	9 1 10
600,070	London United Trams. (1901) 1 to 50,007	10	3 %	3 %	Nil	..	1 1/4 — 2 1/4	1 1/4 — 2 1/4	..	..	..	Nil
399,930	Do. do. 60,008 to 100,000	10	3 %	3 %	Nil	..	1 1/4 — 2 1/4	1 1/4 — 2 1/4	..	..	..	Nil
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	3 3/4%	..	2 — 2 1/4	2 — 2 1/4	..	..	..	15 0 0
1,649,930	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	67 — 71	67 — 71	70 1/2	69 1/2	..	5 12 8
5,782,062	Metropolitan Consolidated	100	1 %	3/4%	3/4%	1 %	39 1/4 — 39 3/4	38 1/2 — 39 1/4	39 1/2	38 1/2	— 1/2	2 10 11
2,640,914	Do. Surplus Lands	100	2 3/4%	2 3/4%	2 3/4%	2 3/4%	66 — 68	66 — 68	67 1/2	66 1/2	..	4 0 11
3,235,000	Do. District	100	Nil	Nil	Nil	Nil	21 1/2 — 22	20 1/4 — 20 3/4	21 1/4	20 1/8	—1/4	Nil
391,337	Metropolitan Electric Trams., Ord.	1	..	..	4 1/4%	..	31/32 — 1 3/32	31/32 — 1 3/32	..	..	..	5 15 0
314,016	Do. do. Defd.	1	Nil	Nil	Nil	..	1/16 — 1/8	1/16 — 1/8	1/3	..	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	29/32 — 31/32	29/32 — 31/32	17/-	16/3	..	5 9 7
595,600	Do. do. 4½ % Deb. Stock Red.	100	4½%	4½%	4½%	4½%	96 — 99	96 — 99	96	95 1/8	..	4 10 11
$10,823,200	Mexico Trams Co., Common Stock	..	..	..	..	6 %	122 1/2 — 124 1/2 xd	121 —123	123 1/2	..	—1 1/2	4 17 7
$9,000,000	Do. 1st Mort. 50-year 5 % Gld. Bds.	..	..	..	5 %	5 %	97 1/2 — 98 1/2	97 1/2 — 98 1/2	98 1/4	97 3/4	..	5 2 0
245,500	Potteries Electric Traction	1	4 %	4 %	Nil	..	1/8 — 3/16	1/8 — 3/16	..	..	..	..
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	3/4 — 1	3/4 — 1	..	..	..	6 17 11
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	82 — 85	82 — 85	..	..	..	5 3 6
37,350	Telegraph Construction and Maintenance	12	15 %	17½%	15 %	17½%	33 — 35 xd	33 1/2 — 35 3/4	35 1/2	34 3/8	+ 3/4	5 17 8
140,000	Do. 4 % Deb. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..	3 19 3
1,000,000	Underground Electric Railway, 5 % Prior Lien	..	..	..	5 %	..	101 1/2 — 102 1/2	102 —103	102 3/8	102 3/8	+ 1/2	4 17 1
2,800,000	Do. do. 4½ % Bonds	..	..	..	4½%	4½%	86 — 88	86 — 88	87 3/8	..	..	5 2 3
4,900,000	Do. do. 6 % Income Bonds	..	..	..	..	..	34 — 36	34 — 36	..	..	..	..
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	1	Nil	10 %	5 %	Nil	1/8 — 3/16	1/8 — 3/16	..	..	..	..
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	..	6 %	6 %	3 %	1 1/4 — 1 3/8	1 1/4 — 1 3/8	..	..	..	8 11 5
245,495	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	60 — 70	60 — 70	..	..	..	5 14 4

ELECTRICITY SUPPLY COMPANIES.

30,449	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10%	10 %	10 %	10 %	7 1/4 — 7 3/8	7 1/4 — 7 3/8	7 5/16	7 3/8	..	6 9 0
9,551	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7 — 7 1/2	7 — 7 1/2	..	..	..	4 13 4
400,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..	3 18 5
60,000	Charing Cross and Strand Electricity Supply	5	5 %	5 %	5 %	5 %	3 1/2 — 4	3 1/2 — 4	..	..	..	6 5 0
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4 1/4 — 4 3/8	4 1/4 — 4 3/8	..	..	..	4 16 0
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3 7/8 — 4 1/8	3 7/8 — 4 1/8	..	..	..	4 17 0
445,736	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	97 — 99	97 — 99	..	..	..	4 2 6
49,436	Chelsea Electricity Supply, Ord.	5	4½%	4½%	4½%	4 %	3 7/8 — 4 1/4	3 7/8 — 4 1/4	..	..	..	5 5 11
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	99 —101	99 —101	101	..	..	4 9 1
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	6 %	6 %	6 %	7 %	11 3/8 — 11 7/8	11 3/8 — 12	..	..	+ 3/8	5 16 8
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11 1/2 — 12 3/8	11 1/2 — 12 1/8	..	..	— 3/8	4 18 0
400,000	Do. 5 % Db. Stk.	Stock	5 %	5 %	5 %	5 %	119 —123	119 —123	..	..	..	4 1 4
200,000	Do. 4½ % 2nd. Db. Stk.	100	4½%	4½%	4½%	4½%	99½ —102½	99½ —102½	101½	100 5/8	..	4 7 10
50,000	County of Durham Electrical Power, Ord.	5	4 %	2 %	Nil	Nil	1 1/4 — 2	1 1/4 — 2	..	..	..	Nil
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	2 1/2 — 3 1/4	2 1/2 — 3 1/4	..	..	..	7 13 10
250,000	Do. do. do. 5 % 1st Mtg. Deb.	Stock	..	..	5 %	5 %	94 1/2 — 96 1/2	94 1/2 — 96 1/2	..	..	..	5 3 8
40,000	County of London Electric Lighting, Ord. 1—40,000	10	5 %	5 %	5 %	5 %	7 1/2 — 8	7 1/2 — 8	7 7/8	..	..	6 5 0
55,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10 3/4 — 11 1/4	10 3/4 — 11 1/4	..	..	..	5 6 8
400,000	Do. do. 4½ % Deb. Stock	Stock	4½%	4½%	4½%	4½%	103 1/4 —106 1/2	103 1/4 —106 1/2	105 1/8	..	..	4 4 6
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	99 —102	99 —102	101	100 1/2	..	4 8 3
80,000	Edmundson's Electric Corporation, Ord. Shares	5	Nil	Nil	Nil	..	3/32 — 1/8	3/32 — 1/8	..	..	..	Nil
80,000	Do. do. 6 % Cum. Pref.	5	3 %	Nil	Nil	..	1 1/4 — 1 1/2	1 1/4 — 1 1/2	..	..	..	Nil
430,500	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	..	74 — 77 xd	75 — 78	75 1/2	..	+1	5 15 5
$3,150,000	Electrical Dev. Co. of Ontario, 5% 1st Mtg. Gold Bnds.	$500	..	..	5 %	5 %	85 — 88	85 — 88	86 1/2	..	..	5 8 8
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4 1/4 — 4 3/4	4 1/4 — 4 3/4	..	..	..	5 15 9
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	5 %	5 %	5 %	5 %	5 — 5 1/4	5 — 5 1/4	..	..	..	4 10 11
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
15,000	Hove, 1 to 15,000	5	9 %	8½%	8½%	8½%	7 — 7 1/2	7 — 7 1/4	..	..	..	5 13 4
$1,376,000	Kaministiquia Power Co., 5 % Gold Bnds.	100	..	..	5 %	5 %	100 —102	100 —102	100 1/2	..	..	4 18 0
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	10 %	8 %	8 %	7 — 7 1/2	7 — 7 1/2	..	..	..	5 6 8
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	94 1/2 — 96 1/2	94 1/2 — 96 1/2	..	..	..	4 2 11
11,000	London Electric Supply Corporation, Limited, Ord.	3	4 %	2 1/2%	3 %	..	1 3/8 — 2	1 3/8 — 2	..	..	..	4 8 11
70,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	..	5 — 5 1/2	5 — 5 1/2	5 5/16	5 1/8	..	5 14 3
382,355	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4½%	4 %	4 %	90 — 92	90 — 92	92	..	..	4 7 7
200,000	Metropolitan Electric Supply, 1 to 100,000	5	8 %	6½%	5 %	5 %	3 1/4 — 3 3/8	3 1/4 — 3 3/8	..	..	..	6 13 4
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4 %	4 — 4 1/4	4 — 4 1/4	80/-	..	..	5 0 0
235,000	Do. 4½ % 1st Mort. Deben. Stock	Stock	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..	4 5 9
248,000	Do. 3½ % Mort. Deben. Stock Redeem.	Stock	3½%	3½%	3½%	3½%	82 — 85	82 — 85	..	..	..	4 2 4
$6,000,000	Mexican Electric Light Co., 5% 1st Mtg. Gold Bnds	100	5 %	5 %	5 %	5 %	84 3/4 — 85 1/2	85 — 86	85 3/4	85 1/4	+ 1/4	5 16 3
13,585,000	Do. Light and Power Co., Ltd., Common	$100	..	4 %	3½%	4 %	77 — 79 xd	77 — 79	..	..	..	5 1 3
$2,400,000	Do. do. 7% Cum. Pref. Stk.	Stock	..	..	7 %	7 %	101 1/2 —103 1/2	101 1/2 —103 1/2	103 1/4	101 7/8	..	6 15 3
12,000,000	Do. do. 5% 1st Mtg. Gold Bnds.	100	..	..	5 %	5 %	93 1/2 — 94 1/2	93 1/2 — 94 1/2	95	94 1/8	..	5 5 6
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	95 1/2 — 97 1/2	95 1/2 — 97 1/2	..	..	..	4 12 4
180,491	Newcastle-on-Tyne, 1 to 137,500	5	8 %	8 %	2½%	..	3 1/4 — 4 3/8	3 1/4 — 4 3/8	..	..	..	2 17 1
137,500	Do. 5 % Pref., 1 to 137,500	5	5 %	5 %	5 %	5 %	4 3/8 — 4 7/8	4 3/8 — 4 3/4	..	..	..	5 2 7
150,000	North Metropolitan Electric Power Supply Co., 5 % Mortgages (Red.), Nos. 1 to 1,500	100	..	..	..	5 %	100 —102	100 —102	..	..	..	4 18 0
10,852	Notting Hill Electric Lighting	10	7½%	7½%	7 %	..	12 — 13	12 — 13	..	..	..	5 7 8
20,000	Oxford, 1 to 96 and 407 to 20,310	5	7 %	7 %	7 %	7 %	6 1/2 — 7	6 1/2 — 7	..	..	..	5 0 0
119,694	River Plate Elcty. Co. Ord.	Stock	2½%	6 %	8 %	9 %	210 — 225	210—225	220	..	..	4 0 4
100,000	Do. do. 6% Non Cum. Pref.	Stock	6 %	6 %	6 %	6 %	105 — 115	105—115	101 1/4	..	..	5 4 4
200,000	Do. do. 5% Deb. Stk. Red.	100	5 %	5 %	5 %	5 %	100 1/4 —102 1/2	100 1/2 —102 1/2	..	..	..	4 17 7
40,000	St. James' and Pall Mall Electric Light, Ord.	5	10 %	10 %	10 %	10 %	8 1/4 — 8 3/8	8 1/4 — 8 3/8	..	..	..	5 15 11
90,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	6 7/8 — 7 1/8	6 7/8 — 7 1/8	..	..	..	4 14 11
150,000	Do. do. 3½ % Deb. Stock Red.	100	3½%	3 %	3½%	3½%	84 — 86	84 — 86	..	..	..	4 1 5
12,000	Smithfield Markets Electric Supply, Ord.	5	Nil	Nil	Nil	..	1 1/2 — 2	1 1/2 — 2	..	..	..	Nil
65,000	South London Electric Supply, Ord.	4	3 %	4 %	5 %	5 %	2 3/4 — 3 1/8	2 3/4 — 3 1/8	..	..	..	6 9 0
130,100	Do. do. 5 % 1st Mort. Deb.	100	..	..	5 %	5 %	99 —102	99 —102	100 1/4	100	..	4 18 0
120,000	South Met. Elec. Lt. & Power, Ord.	1	2½%	2½%	2½%	..	1/4 — 3/8	1/4 — 3/8	..	..	..	5 0 0
142,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1 — 1 1/8	1 — 1 1/8	..	..	..	6 4 5
224,520	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	..	1/4 — 1	1/4 — 1	..	..	..	20 0 0
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	2 — 2 1/2	2 — 2 1/2	..	..	..	10 0 0
275,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	4½%	4½%	4½%	4½%	79 — 81	79 — 81	..	..	..	5 11 1
808,000	Victoria Falls Power Co., Pref. Nos. 1 to 808,000	1	..	..	5 %	..	3/4 — 7/8	3/4 — 7/8	15/-	..	..	5 14 3
100,000	Westminster Electric Supply, Ord.	5	12 %	10 %	10 %	10 %	8 3/8 — 8 5/8	8 3/8 — 8 5/8	..	..	..	5 12 8
51,279	Do. do. 4½ % Cum. Pref. (Reduced from 5% since 31st Dec., 1905)	5	4½%	4½%	4½%	4½%	4 3/8 — 5 1/8 xd	4 3/8 — 5 1/8	5 1/4	5 5/32	..	5 1 5

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange.

Bank rate of Discount 3 per cent. June 9th, 1910.

TRADE STATISTICS OF MEXICO.

THE following figures, showing the imports of electrical and similar materials into Mexico during the year ended June 30th, 1908, are taken from the recently-issued official trade statistics; the figures for the previous year are given for purposes of comparison, with notes of increases or decreases :—

Peso = 4s.

	1907-8. Pesos.	1908-9. Pesos.	Increase or decrease. Pesos.
Copper, brass or bronze wire, covered with other materials.—			
From Germany	187,000	58,000	— 129,000
„ Austria	8,000	5,000	— 3,000
„ United States	642,000	279,000	— 363,000
„ France	1,000	1,000	—
„ Great Britain	2,000	1,000	— 1,000
„ Other countries ...	1,000	1,000	—
Total ...	841,000	345,000	— 496,000
Copper, brass or bronze wire, bare.—			
From Germany	182,000	24,000	— 158,000
„ United States	345,000	87,000	— 258,000
„ Great Britain	4,000	5,000	+ 1,000
„ Other countries ...	3,000	1,000	— 2,000
Total ...	534,000	117,000	— 417,000
Cables of copper, brass, &c., not armoured.—			
From Germany	45,000	51,000	+ 7,000
„ Austria	—	4,000	+ 4,000
„ United States	450,000	449,000	— 1,000
„ Great Britain	87,000	3,000	— 84,000
„ Other countries ...	3,000	2,000	— 1,000
Total ...	585,000	509,000	— 76,000
Cables of copper, &c., armoured.—			
From Germany	82,000	90,000	+ 8,000
„ United States	126,000	50,000	— 76,000
„ Great Britain	63,000	17,000	— 46,000
„ Other countries ...	1,000	5,000	+ 4,000
Total ...	272,000	162,000	— 110,000
Iron wire.—			
From Germany	259,000	125,000	— 134,000
„ United States	433,000	231,000	— 202,000
„ Great Britain	21,000	13,000	— 8,000
„ Other countries ...	7,000	8,000	+ 1,000
Total ...	720,000	377,000	— 343,000
Rails.—			
From Germany	399,000	59,000	— 340,000
„ Belgium	117,000	40,000	— 77,000
„ United States	1,511,000	2,894,000	+ 1,383,000
„ Great Britain	443,000	274,000	— 169,000
„ Other countries ...	53,000	2,000	— 51,000
Total ...	2,523,000	3,269,000	+ 746,000
Insulators of glass or porcelain.—			
From Germany	50,000	30,000	— 20,000
„ Austria	4,000	3,000	— 1,000
„ United States	81,000	59,000	— 22,000
„ Other countries ...	2,000	2,000	—
Total ...	137,000	94,000	— 43,000
Commutators, interrupters, contacts, safety cut-outs, &c.—			
From Germany	218,000	144,000	— 74,000
„ Austria	23,000	10,000	— 13,000
„ United States	497,000	308,000	— 189,000
„ France	12,000	7,000	— 5,000
„ Great Britain	10,000	4,000	— 6,000
„ Other countries ...	3,000	7,000	+ 4,000
Total ...	763,000	480,000	— 283,000
Arc lamps.—			
From Germany	44,000	35,000	— 9,000
„ United States	69,000	29,000	— 40,000
„ Other countries ...	2,000	5,000	+ 3,000
Total ...	115,000	69,000	— 46,000

	1907-8. Pesos.	1908-9. Pesos.	Increase or decrease. Pesos.
Incandescent electric lamps.—			
From Germany	Not shown separately.	67,000	—
„ Austria		4,000	—
„ United States		53,000	—
„ Other countries ...		3,000	—
Total ...	—	127,000	—
Machines for industries, mining, &c.—			
From Germany	2,904,000	2,310,000	— 594,000
„ Austria	35,000	16,000	— 19,000
„ Belgium	91,000	68,000	— 23,000
„ Canada	10,000	18,000	+ 8,000
„ Spain	90,000	55,000	— 35,000
„ United States	19,148,000	12,108,000	— 7,040,000
„ France	559,000	497,000	— 62,000
„ Great Britain	3,670,000	3,571,000	— 99,000
„ Italy	10,000	35,000	+ 25,000
„ Sweden	81,000	39,000	— 42,000
„ Switzerland	237,000	145,000	— 92,000
„ Other countries ...	15,000	15,000	—
Total ...	26,850,000	18,877,000	— 7,973,000
Carriages of all kinds for railways, &c.—			
From Germany	28,000	41,000	+ 13,000
„ United States	3,255,000	1,489,000	— 1,766,000
„ France	3,000	95,000	+ 92,000
„ Great Britain	197,000	189,000	— 8,000
„ Other countries ...	2,000	—	— 2,000
Total ...	3,485,000	1,814,000	— 1,671,000
Asbestos sheets, &c.—			
From Germany	3,000	3,000	—
„ United States	174,000	94,000	— 80,000
„ France	1,000	2,000	+ 1,000
„ Great Britain	4,000	1,000	— 3,000
„ Other countries ...	4,000	—	— 4,000
Total ...	186,000	100,000	— 86,000
Scientific instruments and apparatus.—			
From Germany	112,000	84,000	— 28,000
„ United States	170,000	155,000	— 15,000
„ France	85,000	56,000	— 29,000
„ Great Britain	13,000	27,000	+ 14,000
„ Italy	8,000	3,000	— 5,000
„ Other countries ...	2,000	4,000	+ 2,000
Total ...	390,000	329,000	— 61,000

THE CONTINENTAL ELECTRICAL ENGINEERING INDUSTRY.

THE question whether a company has legal power to pay out of capital interest on new shares, during the period of the construction of extensions of works for which the capital has been raised, is to form the subject of a friendly action in the highest court in Germany. The case affects the Berlin Elevated and Underground Railway Co., and is due to the initiative of the Deutsche Bank, acting apparently on behalf of certain of its clients. A similar step to that of the company in question, it has just been ascertained, had previously been taken by the Stuttgart Tramways Co., which decided in December, 1908, to issue £112,500 in new shares for the extension of lines in the suburbs, the shares becoming entitled to dividend as from January 1st, 1911. In the meantime, however, the interest on the new capital is being paid out of revenue from the opening of the extensions down to the end of 1910, but interest payments had previously been made out of capital during construction. It is considered that the decision as to legality in the case of the Berlin company will also be of importance in regard to the Stuttgart tramways.

GERMAN WORKS.

The directors of the Duisburg Cable Works Co. (Kabelwerk Duisburg) state in their report for 1909 that the works had sufficient employment, but the prices of all products further declined, particularly when the temporary dissolution of the Cable-Makers' Syndicate took place. During the three months over which the combination had no control the unrestrained competition which prevailed induced consumers to enter into contracts in connection with which there was no question of any profit. The reconstitution of the syndicate in May certainly terminated selling below cost price, but the contracts previously concluded, unfortunately, still affected the whole cable industry at the present time. The prices for insulated conductors and insulating tubes were exceptionally unfavourable, and although an attempt was made at the end of the year to form a syndicate for insulated conductors, it proved to be unsuccessful. After providing for deprecia-

tion to the extent of £11,800, as contrasted with £9,930 in 1908, the accounts exhibit a net available surplus of £8,740, as against £12,500 in the preceding year. A dividend is contemplated at the rate of 10 per cent. for 1909 on a share capital of £75,000, being the same rate as in the previous 12 months.

The shareholders in the Voigt & Haeffner Co., of Frankfort-on-Main, have approved the payment for 1909 of a dividend at the rate of 10 per cent. on the share capital of £150,000, being the same rate as in the preceding year. According to the directors' report, the slower course of business continued and signs of a gradual improvement in the general situation only manifested themselves late in the autumn. As a consequence, the value of the turnover was slightly less than in 1908, as the prices of all products declined owing to the extraordinarily severe competition and price cutting. The inland mines and ironworks, as well as in part the increasing number of overland central stations, were good customers, but export markets were less responsive in consequence of advance in foreign manufacturing and the difficulty of competing owing to higher import duties. The net profits amounted to £27,400, as against £31,200 in 1908. It was stated at the recent meeting that the orders in the present year have substantially increased as compared with the corresponding period in 1908.

The Electrical Enterprises Co. (Gesellschaft für Elektrische Unternehmungen), of Berlin, which has a share capital of £2,250,000, and a bond issue of £1,651,000, reports having extended its scope of activity in 1909 by participating in an increasing degree in overland central stations, in addition to tramways and city electricity works on the one hand, but on the other the holdings in manufacturing works were further reduced in order to be free from the influence on the total results of the fluctuations in the general condition of trade. Among the sales are mentioned those of shares in the A.E.G., but the company still holds £39,820 in the British Thomson-Houston Co. Including the balance forward, the accounts show net profits of £219,000, as compared with £184,000 in 1908, and a dividend of 8 per cent. is proposed as in each of the three preceding years.

The report for 1909 of the Heddernheim Copper Works and South German Cable Works Co. (Kupferwerk und Suddeutsche Kabelwerke), of Frankfort-on-Main, covers the first year's working since the amalgamation of the two undertakings. After appropriating the sum of £15,500 for depreciation in 1909, as compared with £14,200 in the case of the two companies in 1908, and allocating £2,010 to the reserve fund, as against £2,970, the accounts show net profits of £41,400, as contrasted with £41,000 in 1908. It is proposed to pay a dividend at the rate of 7 per cent. on the share capital of £400,000, this comparing with 7 per cent. in the instance of the copper works on £250,000 in 1908 and 8 per cent. in that of the cable works on a capital of £150,000 in 1908.

The principal works of the Elektrochemische Werke, of Berlin, are leased to the Griesheim-Elektron Chemical Co., the former only carrying on an oxalic acid factory. As gross profits from the lease, from manufacturing and from participation in profits the accounts indicate a total of £76,000 for 1909, as compared with £74,700 in the preceding year. After providing for interest on loans, management expenses and extra depreciation on patents, the net profits and balance brought forward are returned at £63,700, as against £61,600 in 1908. It is intended to distribute 10 per cent. on the share capital of £275,000, which is entirely held by the Zurich Bank for Electrical Enterprises, this being the same rate as was paid for 1908.

SWISS AND OTHER WORKS.

The Elektrizitäts Gesellschaft Alioth, of Basle, reports that the hoped-for improvement did not take place in 1909, and competition increased, with correspondingly lower prices; but notwithstanding this state of affairs, the orders received were somewhat more abundant than in 1908. On the other hand, copper and other raw materials were cheaper, and it was also possible to reduce working expenses by the introduction of considerably improved methods of manufacture. The gross profits amounted to £36,700, and a dividend at the rate of 6 per cent. has been declared on the ordinary and preference capital of £120,000, being the same as in 1908. As far as electric traction is concerned, the directors state that further trials are proposed to be made with the 2,000-H.P. locomotive for main line traffic, and that the company was well employed on railway work. The company delivered 1,210 transformers of 75,562 KW. in 1909 and 4,650 generators and motors of 107,701 H.P., as compared with 90,901 KW. and 130,051 H.P. respectively in 1908.

The report of the Motor Applied Electricity (Ges. fur Angewandte Elektrizitat) Co., of Baden, which is closely associated with the Swiss Brown-Boveri Co., states that the improvement in the general prospects which started in the spring of 1909 led to an increase in the offers of electrical schemes made to the company, some of which received closer consideration. As a consequence of the favourable conditions of the water sources of the companies working hydro-electric stations, the latter were able to carry on without making noteworthy demands upon their steam plant held in reserve. Apart from works in which the company is interested, its own works represent a book value of £350,000. The net profits realised by the company were £51,300, as against £46,000 in 1908, and a dividend of 6 per cent. has been declared on the ordinary share capital of £700,000 as compared with 6 per cent. on slightly less capital in 1908; whilst the bond capital amounts to £600,000.

The report of the A.E.G.-Thomson-Houston, Società Italiana di Elettricità, of Milan, states that notwithstanding the continuance of the crisis in Italy, the company realised satisfactory results in 1909, in consequence of the constant progress of electricity and the extension of its application to new branches. During the year the hydro-electric station on the Adamello was completed, this being the first in Europe to have such a high working pressure as 72,000 volts. The tramways in the province of Brescia of a length of nearly 33 miles, the single-phase railway from Naples to Piedimonte having a length of 50 miles, and the Ferrara tramways were also finished in 1909. The new factory at Milan was set in operation, and was already supplying a portion of the requirements in traction plants. The net profits amounted to £23,000, and it is proposed to pay a dividend of 6 per cent. on the capital of £360,000, being the same rate as in 1908.

The directors of the Tecnomasio Italiano Brown-Boveri, of Milan, state in their report for 1909 that, despite the unfavourable situation of trade in general, the company succeeded in increasing the turnover from £188,000 in 1908 to £244,000 last year. Work was begun in the course of the year in the new shop destined for the construction of heavy machines in the Corso Lodi. Among the important orders received are mentioned those for three transformers of 2,200 KW. each for the Bardoneschia station on Mont Cenis, four three-phase alternators, each of 9,000 H.P. at 6,000 volts, for a works near Pescara, and seven transformers, each of 3,600 KW., which are to step up from 6,000 volts to the hitherto, in Europe, unattained pressure of 88,000 volts. The directors are devoting attention to electric traction, the material for which Italy has hitherto been compelled to import. The accounts show net profits of £17,000, as against £14,600 in 1908, and the dividend is at the rate of 6 per cent., as in 1908.

The Felten & Guilleaume Co., of Vienna, which owns cable and steel and copper works, reports that satisfactory employment was experienced in 1909 on the whole, as the turnover attained the level of that obtaining in the preceding year. Further improvements were made in the plant, and this rendered it possible, at least in part, to equalise the repeated reductions in prices in the iron department. As far as the present year is concerned, the directors state that business has become unmistakably slower, and scarcely any orders have been received from the State. As Government contracts are of considerable importance in regard to the activity of the company, the question has had to be borne in mind in forming an opinion of the future, and this circumstance has induced the directors to reduce the dividend from 17½ per cent. in 1908, to 15 per cent. for 1909, the net profits being 2,567,000 crowns and 2,523,000 crowns in the two years respectively.

The Austrian Allgemeine Elektrizitäts Gesellschaft reports net profits of £48,650 for 1909, and proposes to pay £1 per share, being the same rate as in 1908.

The Hungarian Felten & Guilleaume Co. earned net profits of £23,790 in 1909, as compared with £22,200 in the previous year. The dividend is at the rate of 15 per cent., as in 1908.

The Cable Works Co., of Vienna and Pressburg, contemplates the distribution of 11 per cent. for 1909, or the same rate as in 1908; and the Ganz Electricity Co., of Budapest, 5 per cent., as in the preceding 12 months.

PROCEEDINGS OF INSTITUTIONS.

Commutation Phenomena and Magnetic Oscillations Occurring in Direct-Current Machines.

By G. W. WORRALL, M.Sc., A.M.I.E.E.

(Abstract of paper read before the INSTITUTION OF ELECTRICAL ENGINEERS *at Birmingham, April 27th, 1910.)*

THE experiments described in this paper were undertaken as an extension to direct-current machinery of the investigations upon alternators which the author had previously been engaged upon.

The magnetic oscillations were observed by means of E.M.F.'s induced in search coils placed on the machine parts in such positions as to link the oscillating flux. The E.M.F. waves were photographically recorded by means of a Duddell high-frequency oscillograph and revolving drum camera. The machine employed in the investigation was a two-pole generator with adjustable commutating poles; the brushes were of carbon, and of a width equal to one commutator segment plus insulation.

Potential difference on load, 80 volts; current, 20 amperes; speed, 750 R.P.M.; exciting current, 1 ampere; normal commutating pole current, 5 amperes; brushes in geometrical neutral plane; number of conductors, 270; turns per coil, 3; coils per slot, 2; number of slots, 45; number of commutator segments, 45; average current density in brush contact surface, 5 amperes per cm.^{2}; kind of carbon used, le Carbone "Z."

The analysis of the oscillations recorded was only possible by the accurate knowledge of the position of the armature corresponding to a point on the oscillograph record. This was obtained by means of a contact maker placed on the shaft of the machine, and connected up to the oscillograph in the way devised by the author for the previous researches. During the instant of contact the oscillograph was shunted by a small accumulator, thereby producing a momentary current, and hence an isolated peak in the record which was being taken. This peak corresponded to a predetermined position of the armature. The contact maker was in all cases set at the beginning of short-circuit by the negative brush.

The contact-maker employed was that described by Arnold in "Die Gleichstrommaschine," Vol. 1. It was found to be absolutely certain and accurate; the duration of contact was, at the normal speed of the machine, considerably less than $\frac{1}{10000}$th part of a second.

The magnetic oscillations occurring are due to two main causes:—

1. The movement of the armature teeth in the magnetic field.

2. The commutation of the armature current in the short-circuited coil.

The first class of oscillation was fully dealt with in the previous papers on alternators above referred to, and the results then obtained apply equally to direct-current machines. The oscillations of the second class were found to be far more important, and in most parts of the machine greater in magnitude than those of the first class. These oscillations were due to the change of current in the short-circuited coils, and since there were two such coils there were two sets of oscillations which were displaced relatively to each other 180°, owing to the number of commutator segments being odd.

Although the currents in the two coils changed in relatively opposite directions, the position of one coil was the reverse of that of the other, and hence the magnetic oscillations produced were in the same direction. Thus the number of oscillations occurring in a revolution of the machine was twice that of the commutator segments.

The coil at the instant of short circuit was opposite to a pole-piece and linked the main flux, hence the magnetic oscillation caused a pulsation in the main magnetic circuit which could be readily observed by means of a search coil wrapped round the pole-shoe.

The nature of the magnetic oscillation depends upon the nature of the commutation taking place, and since the flux at each instant is proportional to the current in the short-circuited coil, the E.M.F. induced in a search coil linking the flux forms a picture of the commutation taking place. Such a picture of commutation was found to be a most accurate and sensitive guide to the general behaviour of the machine, inasmuch as its production was continuous and did not interfere with any of the working parts.

The usual method of commutation research is to measure the short-circuit current directly by means of a resistance inserted in an armature coil, but this method only gives results for two adjacent segments and the coil between them, and gives no indication of the nature of the commutation taking place at other points of the commutator. Such results are liable to be very misleading, for the experimenter cannot be sure that the brush is making good and uniform contact, but a record of the commutation taking place over the whole circumference of the commutator forms a reliable guide. The resistance inserted in the armature coil generally requires to be greater than the resistance of the coil itself, and is liable to influence the results obtained, and in any case there is nothing to show what influence the resistance has.

The method adopted in this research is free from all such objections, and by its means many interesting and important phenomena have been brought to light.

The theory of commutation has been the subject of very considerable discussion in recent years. On the one side it is stated that commutation should take place in a neutral field, while on the other it is stated that commutation should take place in a commutating field.

Both lines of reasoning lead to the same result, and the apparent diversity of opinion is merely due to different methods of expression. The conditions for good commutation cannot hold in practice during the whole of the commutation period, but only during the final instant. It is, however, generally possible to obtain satisfactory commutation without compensating or rendering non-existent the self-induction E.M.F. of the coil. This may be effected by a proper choice and disposition of the contact resistance of the brush.

The choice of the resistance has already been studied by many investigators, but few have dealt with its disposition. The use of a carbon tip to a copper brush, and Kapp's patent, in which the resistance of the forward tip of the brush is increased by means of holes in the contact surface, are attempts in this direction, but the proper disposition of the resistance over the contact surface may be carried much further than this.

The resistance of the contact surface over the rear segment must be very low compared with that over the forward segment, and this relation must hold not merely at the end of the period but quite early in the period. This disposition of the resistance may be approximated to by cutting away a portion of the surface of an ordinary brush as shown in fig. 1. In this way the resistance to the forward segment is made high before, say, one-half of the short-circuit period has expired.

The potential difference forcing the current to change is made high during the early portion of the short-circuit period, and hence the commutation is accelerated at the beginning instead of at the end of the period. This prevents a rush of current at the final instant, and renders the current change much smoother. The magnitude and disposition of the contact resistance and the self-induction of the coil determine what may be called the natural period of commutation, while the mechanical design and speed of the machine determine the available period. The natural period may be defined as the time required for the current to commutate under the conditions existing in the circuit of the coil, while the available period is the duration of the short circuit.

Although theoretically the current would always occupy the whole of the available period in commutating, practically the current would reach a value closely approximating to its final value in a certain definite time which may be less than the available period. The available period in a given machine is proportional to the speed, but the natural period was found to be but slightly influenced thereby. The relation which the one period bears to the other, and the actual magnitude of the natural period, determine the efficiency of commutation. By efficiency is meant not merely whether the commutation is sparkless or not, but whether the commutation takes place with the maximum rate of change of current at its lowest possible value. The sparking is determined by the relation of the two periods alone; if the natural period be less than the available, no sparking will take place, for commutation will be complete before the short-circuit period expires; when the two periods are just equal the critical sparking conditions exist, and when the available period is less than the natural, the latter is concluded by a spark. The simplest way of varying this relationship is by varying the speed of the machine. Hence there is a certain critical speed below which the machine is sparkless and above which sparking takes place.

If the natural period be less than the available, the value of the maximum rate of change of the current depends upon the duration of the natural period alone, for if the self-induction of the short-circuited coil remain constant, the natural period is dependent upon the magnitude and disposition of the contact resistance of the brush. If these be unsuitable the change of current will be retarded at the commencement of commutation and will be rapidly accelerated at the end. If, however, they be properly chosen, the change of current will be slow at the end of commutation and accelerated during the early stages. The effect of this will be to reduce the maximum value of the rate of change of current over the whole period. Such an acceleration during the early stages of commutation will reduce the duration of the natural period and effect a better distribution of current over the contact surface. Hence although the reduction of the contact surface already described and shown in fig. 1 increases the apparent current density over the contact surface, the actual current density may be diminished.

FIG. 1.

When the conditions are such that the natural period cannot be adjusted sufficiently to obtain efficient commutation, an external or commutating E.M.F. must be introduced into the circuit. The primary effect of such an E.M.F. should be to accelerate the change of current during the early part of commutation, and not merely to compensate the self-induction of the coil at the end of the period. Such an accelerating effect may be considered as a compensation of the self-induction, but in whatever light it be regarded, it is essential that it be effective during the early portion of the period. The actual magnitude of the commutating E.M.F. required depends upon the natural period of the coil; if the E.M.F. be too small or in the wrong direction, sparking will take place at the forward tip of the brush. If, however, it be too large, sparking will take place at the rear tip. Sparking in the former case is due to the available period being too short, and in the latter case is due to the rush of current which takes place instantly the coil is short-circuited, and to the consequent heating of the first contact. Between these two extreme cases there is a gradual shifting of the commutation backwards from the forward tip of the brush to the rear as the commutating E.M.F. is increased.

If the commutating E.M.F. be provided by means of commutating poles, the presence of the latter considerably increases the self-induction of the coil and the flux due to armature reaction in the commutating zone. The latter must be opposed by an equal flux from the commutating poles before any commutating E.M.F. is generated in the short-circuited coil.

It is well known that the contact resistance of the positive brush is different to that of the negative brush, and hence when the conditions of commutation are suitable for a brush of one polarity they are not necessarily suitable for a brush of the opposite polarity. In fact, it is quite possible, as indeed was found in this research, for an alteration of the conditions which improves the commutation under the negative brush to seriously deteriorate the commutation under the positive brush. Thus, for example, the slit cut in the brush, as in fig. 1, may improve the commutation under the negative brush, but may render the commutation under the positive brush much worse.

The theoretical conclusions enumerated above were found to be experimentally true, but serious difficulties were encountered in connection with the brush-holder.

FIG. 2.

In the early stages of the research it was found that the commutation was exceedingly irregular; not only was it different for different segments, but it changed from time to time. It was thought that these irregularities were mainly due to mechanical defects of the brush-holder; and as the work proceeded, this view was fully confirmed.

The commutator was turned up and the mica scraped out from between the segments to a depth of about 1 mm. Several types of brush-holder were tried, including the finger and reaction types, but with all these the contact surface was by no means constant.

This was found to be due to a variable coefficient of friction between the carbon and the commutator surface, and to slight differences in the commutator surface.

A few examples of the commutation oscillations obtained are given in fig. 2, and a comparison of these records with those given later, will show the unreliable nature of the commutation effected by the ordinary type of brush-holder. A new brush-holder was designed and constructed entirely free from these objections, and was used in all the experiments described in this paper.

The views shown in figs. 3 and 4 illustrate the brush-holder. Fig. 3 shows the holder put together for use, and fig. 4 shows the various parts.

The holder consists of a carrier A mounted on the brush-bar and clamped thereon by the screw B. A double plate C is mounted and capable of sliding on the carrier A, and is guided in its motion by

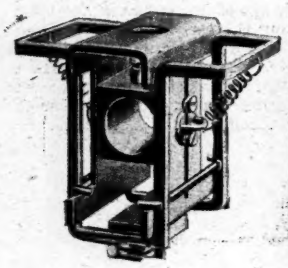


FIG. 3

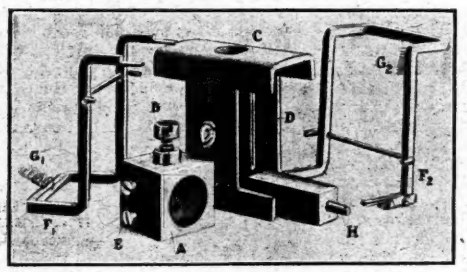


FIG. 4.

a stud working in the slot D, and can be clamped in any position by the screw E. Two metal frames, F_1 and F_2, are held against this plate by the springs G_1 and G_2, respectively, in the positions shown. Their lower ends are formed into half-bearings, which press on to the axis H, upon which the carbon is mounted. The carbon is free to rotate upon the axis H, and is prevented from moving with the commutator by the tangential force exerted by one of the frames F; one frame corresponds to each direction of rotation, and is inoperative in this respect when the rotation is reversed. Either end of the brush axis is free to lift independently of the other end. Hence the brush is free to adjust its position to any change in the commutator surface radially, circumferentially and laterally.

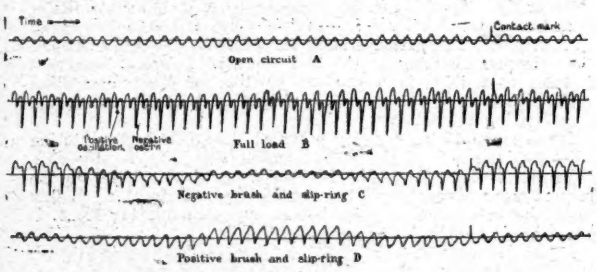


FIG. 5.

When this brush-holder was in use the surface of the carbon was always uniform, and the commutation remained always the same, even if the brush were removed and then replaced.

The commutation phenomena were experimentally studied by means of the magnetic oscillations recorded in a coil on the pole-shoe.

The oscillations recorded were due both to the movement of the teeth in the main magnetic field and to the commutation of the armature current; but, as will be seen from fig. 5, the two kinds of oscillations were easily distinguished from each other. In this figure A shows the tooth oscillations alone as recorded on open circuit, and B the oscillations recorded on full load. C and D are records obtained by running the machine as a generator with full-load resistance in circuit, but with only one commutator brush down, the circuit being completed through a slip-ring connected to a point in the armature. In these two latter records, when the tapping-point was in the neighbourhood of the commutator brush, only the tooth oscillation was recorded, and as the tapping-point rotated, the commutation oscillation appeared, until when the point was opposite the commutator brush the oscillation reached its maximum value.

The magnitude of the positive brush oscillation was very much smaller than that due to the negative brush. This difference was not due to any lack of symmetry of the magnetic system, for both brushes behaved in a similar manner when changed in polarity, but entirely to a difference in the natural period of the short-circuited coil when under the positive and when under the negative brush.

Since the magnitude of the positive brush oscillation was less than that of the negative, the natural period of the former was less than that of the latter, and since it may be assumed that the self-induction in the two cases is the same, it follows that the contact resistance of the brush when positive was higher than when negative.

The commutation oscillation consists of a single peak; the magnitude of the peak is proportional to the maximum rate of change of the current in the short-circuited coil, and its magnitude and position in relation to the contact maker indicates the nature of commutation taking place. When the peak is small and occurs early, the commutation is efficient; but when the peak is large and occurs late in the period, the commutation is completed by a rush of current and sparking is liable to take place.

A very marked influence on the commutation was also noted when the commutator was respectively cold and hot. Fig. 6 shows the records obtained. A was recorded when the commutator was cold after standing over the week-end; temperature of room 15° C. B was recorded after the machine had been running several hours and the commutator had attained the temperature of 29° C. The negative oscillation increased considerably with rise of temperature, while the positive oscillation diminished slightly. This was caused by a decrease in the contact resistance of the negative brush, while that of the positive brush varied but little.

The influence of the contact resistance on commutation is further demonstrated by fig. 7. A was obtained under normal full-load running conditions, and B was obtained under the same conditions, but when a little petroleum had been rubbed on the commutator. The petroleum increased the contact resistance and thereby reduced the natural period of the short-circuited coil, with the resulting diminution of the oscillation and the maximum rate of change of the current.

It might be thought that an increase in the contact resistance would considerably increase the brush losses, but it must be remembered that with the improved commutation the current more uniformly distributed over the contact surface, and further, the small magnitude of the oscillation will cause the iron losses to be reduced.

A proper disposition of the contact resistance over the brush surface was effected by means of the brush shown in fig. 1. A series of records was taken of the oscillations occurring in the coil on the pole-shoe with various widths of contact surface at the forward tip of the brush. Only the negative brush was varied, as the commutation under the positive brush was already very satisfactory. The negative oscillation was gradually reduced in magnitude as the width of the forward portion of the brush surface was reduced, until the width of the latter was a minimum consistent with mechanical strength.

FIG. 6.

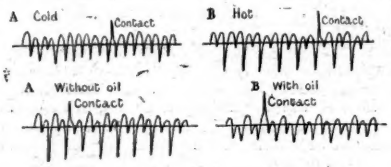


FIG. 7.

In this shape of brush the contact surface of the brush is equally divided between the two segments, when about one-quarter of the short-circuit period has expired, and just before one-half the period the contact resistance over the forward segment is confined to the narrow strip at the forward tip of the brush.

FIG. 8.

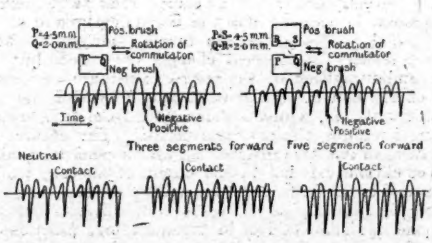


FIG. 9.

The reduction of magnitude of the oscillation is due to earlier commutation; the peak occurs earlier as the contact surface is reduced. The positive oscillation peak remains in a fixed position, and hence the two peaks gradually approach one another.

With a full surface the negative brush had a tendency to spark on full load, but when the forward surface was reduced to 2½ mm. all sparking disappeared, and with a 2-mm. surface the machine could be run on a 75 per cent. overload without any trace of spark-

ing. Thus the overload capacity of a machine may be greatly increased by a suitable disposition of the contact surface.

The same experiment was tried with the positive brush, but with very different results. As will be seen from fig. 8, the positive oscillation was very small even with the full surface, but when the brush was cut away the oscillations immediately increased to about the same magnitude as those due to the negative with the full surface brush.

The natural period of commutation is but slightly influenced by the speed. The ratio of the available to the natural period diminishes as the speed increases; at a certain critical speed, therefore, the ratio is unity, and this is the critical sparking speed.

This critical speed was quite definite even to a few revolutions, and could readily be determined by gradually increasing the speed until sparks appeared.

The commutation may be accelerated by means of a commutating E.M.F. in the same direction as the main current in the short-circuited coil after commutation.

The effect of the acceleration in reducing the natural period and the maximum rate of change may be readily seen from figs. 9 and 10, on shifting the brushes forward. The magnitude of the negative oscillation gradually diminishes and the peak moves to the left—that is, occurs earlier—as the brush lead is increased. At the same time the positive oscillation is considerably increased.

In the records given in fig. 10 the commutating E.M.F. was induced by means of commutating poles. The width of each pole was $2\frac{3}{4}$ times the armature tooth-pitch. The commutating poles were separately excited and the field was varied from a minimum for no sparking to a maximum for no sparking. Such variation of

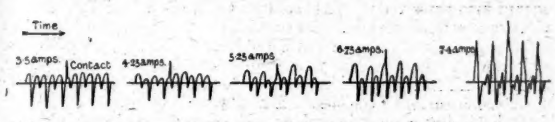


Fig. 10.

the field produced effects similar to those obtained by shifting the brushes above described. The short-circuit current at the end of commutation is clearly shown by the large peak above the zero line.

The presence of the commutating poles increases the self-induction of the coil, and also increases the armature reaction flux in the commutating zone. The latter must be opposed by an equal flux from the commutating pole before any flux is available to generate the required commutating E.M.F. The two fluxes oppose but do not cancel one another in the commutating pole air-gap.

The surface of the commutating poles remains constant, but that of the armature varies as the teeth move past the pole-face. Such variation gives rise to a corresponding change in the magnitude of the armature flux opposed by the commutating pole flux.

The resultant oscillation exhibited by a coil on the commutating pole-shoe forms a convenient method of studying the nature of the field in the commutating pole air-gap. In fig. 11 are given the oscillations recorded corresponding to various commutating pole currents between the two extreme sparking limits.

On record A the main oscillation is due to the armature reaction flux, the slight indent in the oscillation indicates that the commutating pole flux is greater than the armature flux. The indent grows and in record B is about equal to the magnitude of the main

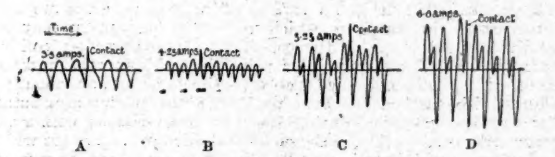


Fig. 11.

oscillation, while in record C the original indent is larger than the original main oscillation. This may be seen by the position of the contact mark relative to the two oscillations. As the commutating pole current is increased, the oscillation of the commutating pole flux rapidly grows until in record D the original indent becomes the main oscillation, and the original oscillation almost an indent.

These records were taken at the same time as those given in fig. 10. A comparison of the two sets of records shows that for no sparking a slight commutation E.M.F. was required, but that there was a large range before the maximum permissible E.M.F. was reached.

This clearly shows that the commutating pole flux fulfils two functions; first, to oppose the armature reaction flux in the commutating zone; and secondly, to provide a commutating E.M.F. Each commutating pole deals with the pole strength of the armature on its own side, and is not influenced by the presence or absence of the other pole. When the commutating flux is small compared to the opposing flux, the ampere-turns required per pole are only slightly greater when only one pole is used than when two are in use, while when the commutating flux is large compared with the opposing flux, the ampere-turns required are practically double. Hence the use of one pole may affect a considerable saving in copper, and the range of commutation is greatly increased.

By using a narrow commutating pole it was found that the oscillation in the tooth could be neutralised, the losses reduced and the efficiency of the machine increased. The flux required would be less, and the ampere-turns could be reduced.

It has been generally observed that the negative brush is much more sensitive than the positive to change in temperature, current density, &c. Two observations in this direction were repeatedly made in this research, viz., that the warm brush vibrated very considerably when negative, but the same brush ran quite smoothly when positive, and that the surface of the negative brush was very much more highly polished than that of the positive. The vibration was entirely prevented by laying about six thicknesses of copper-foil, each 0·035 mm. thick, on the forward tip, and a strip of copper on the rear tip, the metal being held in close contact with the brush by means of a copper clip; the metal was insulated from the carbon by very thin strips of mica.

The reason for this was thought to be as follows: The heat generated at the brush contact surface caused that surface to expand slightly, and the forward tip, being shielded from all draughts by virtue of its position, was subject to the greatest expansion, and actually lifted off the commutator. The lifting was not continuous, but periodic; as a cold segment came under the tip, the latter came into contact with the commutator; but when the segment was heated by the current, the tip was lifted off again. Thus a high-frequency vibration was set up which was communicated to the whole brush. The heat generated at the tip was not readily conducted away by the carbon, but the superior conductivity of the copper strips carried the heat away, and the large surface of the clip served to radiate it. The polished surface of the negative brush was due to its high temperature.

This theory was fully substantiated by experiments.

The highly-polished surface will make better contact, and thus the resistance of the negative brush is lower than that of the positive and the natural period is greater. When the polarity of the brushes was reversed, the negative brush required a long time before the polished surface was worn away, and the positive brush required some time to acquire the polish of the negative, although the latter time was much shorter than the former. The gradual change in the oscillations due to the two brushes when the polarity was reversed could be easily watched in the revolving mirror of the oscillograph.

The difference in temperature between the two brushes is accentuated by the manner of commutation, but if the difference in temperature is the cause of the difference in commutation, the former phenomenon must be due to a cause entirely outside the phenomena of commutation.

Experiments were made in which current was passed from carbon to copper, and also from copper to carbon. In the former case the carbon corresponded to a negative dynamo brush, and in the latter to a positive dynamo brush. It was found that in the former case the temperature rise was from 10 to 20° C. higher than in the latter.

The author had no opportunities of extending the experiments in this direction, but it is evident that this physical fact is the basis for the whole of the phenomena associated with the polarity of the brush.

If the heating of the tip were sufficient, the tip would actually break connection with the segment and strike an arc through which the current would flow. The burning action of the arc produces a brown band on the brush surface and a deposit of the same width on the commutator segment.

The importance of keeping the front tip cool cannot be overestimated, for in it lies to a very great extent the secret of successful commutation. The overload capacity of a machine can be very greatly increased if the brush-tip be kept cool. The metal case in which the brush is usually fitted is not sufficient unless the case almost touches the commutator, and is in very good contact with the carbon.

Since carbon is a very bad heat conductor, any artificial method of cooling must necessarily be deficient, and the best way to avoid a hot tip is to increase the rate of commutation during the early stages of short circuit. This can be effected by the proper distribution of resistance, as already shown, or by a commutating E.M.F. The former method has the advantage of greatly increased stability of the brush.

The E.M.F. waves recorded in coils on the pole-tips appear to be entirely due to the teeth.

The maximum oscillation amounted to 2·54 per cent. on open circuit, and 3·55 on full load, without commutating poles.

The flux oscillations in the main pole-shoe were: on open circuit 0·015 per cent. of the total flux, and at full load 0·022 per cent.

The E.M.F. waves recorded in the various coils on the armature under various conditions of running were also obtained.

This research was carried out at the Technische Hochschule at Karlsruhe, Baden, during the tenure of the Vulcan Fellowship in Engineering, established by the Vulcan Boiler and General Insurance Co., Ltd., at the Victoria University of Manchester.

The author desires to express his indebtedness to Prof. Arnold, of Karlsruhe, for the facilities placed at his disposal, and for his kindly interest in the work.

Discussion.

Dr. Kloss said that if a four-pole lap-wound machine were run with two brushes only in use, then the oscillations induced in a search coil on one of the poles opposite the brushes would contain both sets of oscillations, while that induced in a coil on one of the other poles would contain oscillations due to the movement of the

armature teeth only. By connecting these coils suitably it should be possible to annul the latter and leave only the oscillations due to the commutation currents. Mr. Worrall used a brush whose width was equal to one segment plus insulation only. In practice the brushes used covered more than one segment, and he would like to ask whether the author could give any information as to what happened in this case. He endorsed the remarks about the possibility of improving the performance of a machine by decreasing the contact area of the brushes and increasing the current density. He had known specifications which had stated that the current density in the brushes must not exceed a certain figure, and which left the designer of the machine with the alternatives of either supplying a poor machine in accordance with the specification or a good one in which the specification was departed from. Consulting engineers should leave points like this to the discretion of the designer. It was important to keep down the temperature of the commutator both from the point of view of commutation and in order to prevent mechanical trouble, especially in the case of turbo-generators. This could be done by making the segments hollow and arranging for the passage of air through them, as was done in the Siemens patent ventilated high-speed commutator.

MR. T. F. WALL said that large oscillations were obtained in the coil round the pole piece, whereas on the yoke there were practically none. This probably meant that they had been damped out of the field winding, and that if the oscillograph had been connected across the terminals of the field coil similar results might have been obtained as from the coil on the pole piece. The damping action of the field coils might possibly materially decrease the inductance of the short-circuited coils and thereby improve the commutation of the machine. If records were taken of the E.M.F. induced between the main brushes, the variations of the commutation current might be examined and compared with the records obtained on the pole piece, which latter show the rate of change of the commutation current. It seemed to him that taking a conductor approaching the commutation zone, the lines of force were crowded together behind it and spread out in front. As it passed through the region of commutation this distribution was changed so that the conductor finally left with the flux crowded up in front and spread out behind. As the conductor moved along, the lines followed but did not cut it, so that the actual field in which the coil was moving might quite well be zero.

DR. ING. E. ARNOLD (Karlsruhe) (communicated): In my opinion a commutating field is always necessary in order to compensate the self-induction. Commutation cannot take place in a neutral zone, because the self-induction of the end connections can only be compensated by a field to which a coil side is subject. I agree with the author's remarks about the effect of a brush, the resistance of which increases from the rear tip to the forward tip, but such an increase of resistance occurs also, automatically, with brushes of rectangular section. Experiments have shown that the current density in the parts of a brush that spark is *very small*, and the tension high, thus the contact resistance is very high. Because of very small, almost invisible, sparks at the forward tip, the contact resistance per square millimetre of brush surface on this tip may increase to 50 times that at the rear tip, or even more. Bad contact, as a result of sparking, is the cause of this phenomenon. For the above reasons an artificial disposition of the resistance over the contact surface (as in fig. 1) will not be as successful as one would expect from a theory based on a constant value of the specific resistance. Mr. Worrall's remarks about the construction of brush-holders and the cooling of brushes, are very interesting and important. His experience materially facilitates the design of a good brush-holder. Results of elaborate experiments on commutation have been published by E. Arnold and F. Jordan in "Arbeiten aus dem Elektrotechnischen-Institut der Technischen Hochschule zu Karlsruhe 1908-1909," published by J. Springer, Berlin. This paper deals with the influence of the current density, the inconstancy of the specific resistance of the brushes, the actual duration of the commutation, the losses under the brushes, the reaction of the short-circuit current on the main field, and with field pulsation. The inconstancy of the magnetic field is partly due to *pulsations*, *i.e.*, alterations in the intensity of the field, and partly to *oscillations*, *i.e.*, to a movement of the field alternately with and against the direction of rotation of the armature. The oscillations are caused by the armature teeth passing the poles, and are described as "flash" and "drag" in a previous paper by Mr. Worrall. Equipotential connections damp the pulsations of the field effectively, but not the oscillations, because the plane of the induced equipotential loop coincides with the direction of the field. Solid pole shoes, or, better still, short-circuited windings in the pole shoes (amortiseur) damp the oscillations. Such oscillations particularly affect the commutation of the machines with a large flux per pole. For such machines, solid pole shoes and a long air-gap are thus to be preferred to laminated pole shoes and a short air-gap. It appears that the kind of magnetic oscillations and pulsations and also their magnitude depend upon individual features of the machines. They may be very different for two machines of the same design with the same dimensions. Sometimes a kind of resonance takes place, *i.e.*, the oscillations from various causes strengthen one another. In other cases they may oppose one another. To show the detrimental effect of these pulsations and oscillations of the field, I will mention two cases which came to my notice. The first case relates to a four-pole direct-current motor of 100 H.P., 220 volts, 1,000 revolutions, with 55 slots of 11·5 × 34 mm., 6 conductors per slot and 165 commutator bars. Air-gap 6 mm. The armature is parallel wound without equipotential connections. The motor has four brush arms, each with five brushes of 19 × 45 mm. With 200 amperes the motor began to spark violently and vibrated in consequence of heavy field pulsations The automatic cut-out disconnected the motor because of a sudden increase of the current The motor was thus entirely useless. Commutator bars 1-84, 20-103, 43-126 and 63-146 were then connected by four equipotential connections. The number of commutator bars being odd, only four connections were made on account of lack of symmetry. The result was surprising. The motor was put on load and overload, but no sparking or other detrimental phenomena occurred. The second case relates to a direct-current generator of 550-KW., 2,400 amperes, 230 volts, 90 revolutions, 20 poles. Flux per pole $9{\cdot}45 \times 10^6$. Slot dimensions 10·5 × 50 mm.; air-gap 6 mm. In this machine sparks jumped across the insulation of 0·8 mm. between adjacent commutator bars, on which no brushes rested. It proved to be impossible to cure this trouble, even after long runs. The pressure between two commutator bars, calculated in the ordinary way, was only 9 volts. Other causes must thus increase this pressure momentarily in order to render the phenomenon possible. The machine is now provided with equipotential connections (140 commutator bars are connected to 14 equipotential connections), but has laminated pole shoes. Thus, the field pulsations are damped, and since most probably the phenomenon was due to field oscillations, an effective damping arrangement would suppress the sparks.

PROF. E. W. MARCHANT (Liverpool) (communicated): The design of a brush-holder which will give consistent results for the surface resistance of brushes, is one of the most interesting points in the paper. Mr. Duddell and I did a great deal of work with contact makers about 12 years ago, and we found that the most satisfactory form was one in which two pieces of watch spring clamped to a piece of ebonite supported on the end of the frame of the machine were short-circuited by a copper plate attached to the rotor. The springs projected radially inwards and were about an inch long, soldered into brass rods. This contact maker is exceedingly simple and gave excellent results. In some tests made in the Electrical Engineering Laboratories of the University of Liverpool by Messrs. Cottle and Rutherford, it was found that the ratio of drop in positive brush to drop in negative brush varied within wide limits for different current densities. Mr. Worrall's method of getting rid of chattering is most ingenious. It seems almost incredible that changes in temperature of the brush could be sufficiently rapid to cause chattering, and I should like to ask Mr. Worrall whether he is quite certain that the result obtained was not due to a mechanical effect caused by the addition of the copper and copper foil to the brush.

PROF. DAVID ROBERTSON (Bristol) (communicated): The mathematical theory and the brush shape deduced from it are not of much real value, for the conditions assumed are not those usually found in practice, and several important factors have been left out of account altogether. It is seldom that the brushes are as narrow as one segment width. The mutual inductance of the neighbouring coils being commutated at the same time, even when the phase of commutation is not the same for both, is only a little less important than the self-inductance of the coil itself, and the resistance of the coil and lugs is not usually quite negligible. The author's "natural period" is a rather indefinite sort of thing. With inductance only, the current would never commutate of itself; while with a brush contact resistance only, it would always do so exactly in the available period; with commutating poles it is rather a certain displacement across the poles that is necessary to produce exact commutation, than a certain time. What then is the "natural period," and how is it measured so as to enable the various statements that are made about it in the paper to be justified? Even the "time constant" of the circuit (inductance ÷ resistance) has hardly a definite meaning here, owing to the change both of the inductance and of the resistance of the short-circuit as commutation proceeds. The usual way of applying the oscillograph to show the armature current by splitting a coil and adding the oscillograph shunt through slip rings is of little use, as the behaviour of the current must then be very different from that under normal conditions. In 1903 I devised a method of making the armature coil itself act as the shunt, by which means the phenomena may be studied without changing the conditions of the armature coil by more than 1 or 2 per cent. The principle used is exactly the same as has since been applied by Campbell to the design of non-inductive shunts. The method has been used with the tracing desk outfit for class demonstrations during the past three sessions, with most instructive results. It has shown us that our brushes are too wide, and shows most interesting peaks when they are moved away from the best position. The effect of the mutual inductance is also marked.

PROF. SILVANUS P. THOMPSON (London): Mr. Worrall's paper seems to me one of the most important contributions that have been made for some years to our knowledge of commutation. The new type of brush and brush-holder will probably find a much wider application than in a mere experimental machine in the laboratory. In the machine with an odd number of commutator segments, commutation did not occur simultaneously at the positive and negative brushes; and in this respect the case chosen for the research is not representative of the majority of continuous-current generators. But it would seem that this feature has, for the purposes of the research, been of advantage, as it separated the effects due to commutation at the positive brush from those at the negative brush. This part of the research is very instructive. The results emphasise the analogy that exists between the processes going on in the contact resistances beneath a carbon brush and those going on in an arc lamp. In both cases there is found a resistance which decreases with the current density, and in both cases the resistance is greater for currents leaving carbon than for currents entering carbon. The passages relating to the shaping of the carbon brush, and the suggestion to furnish the tips of all carbon brushes with cooling appliances of metal are of great practical value.

MR. W. ARMISTEAD (Wolverhampton) (communicated): It appears to me that the machine on which the author carried out his experiments was very large for the output, the armature being 10 in. in diameter and the iron 6 in. in length. When my firm were building two-pole machines for such an output we should not have used an armature more than 6 in. diameter with 4½ in. length of iron; then it would have had 624 conductors. The author observes that there may be an actual reduction of temperature when the area of contact between the brush and the commutator is reduced. The experience of my firm bears this out, though, so far as sparking is concerned, we have not found that dividing up the brush by means of a slot or slots parallel to the shaft has been of any use. Large brushes appear to be almost useless, no doubt largely owing to the bad conductivity of the carbon and the impossibility of radiating the heat. The contact between two surfaces such as the brush and the commutator cannot be made into more than three points for each brush, no matter what size. Mr. R. V. Marshall's patent brush and holder is only ¼ in. long along the axis of the commutator. We have tried this arrangement in practice, and find that a large current can be collected per brush with the smaller brushes without an increased rise in the temperature either of the commutator or of the brushes. This small brush will collect practically the same amount of current as one four times the dimensions. Unfortunately, practical difficulties come in the way of its universal adoption. The author speaks of the increased inductance in machines fitted with commutating poles. It always appears to me that this is very much exaggerated. I have found that facing poles with sheet copper, and surrounding them with a stout band of the same material, does not make the slightest difference so far as sparking is concerned. I wonder if the author could tell us why it is that the *contact* resistance between the carbon and the copper of the commutator is reduced by an increase of temperature?

MR. C. C. HAWKINS (communicated): The question whether the self-induced E.M.F. in the case of satisfactory commutation exists and is compensated for, or is rendered non-existent, resolves itself finally into the question of what is the actual physical field in which the short-circuited coil moves. It appears to me that a resultant commutating field must always be present at least in such amount and density as to compensate for the inductance, self and mutual, of the *end connections;* for the flux linked with the latter follows a path entirely different to that of flux entering or leaving the surface of the core. The remainder of the inductance of the short-circuited coils may be resolved into a certain amount due to lines crossing the air gap and a certain amount due to the bending of the final field within the slot and about its neighbourhood. The former part is cancelled by opposing lines, so that it becomes non-existent in the resultant field. The latter part will call for some commutating flux sufficient to counterbalance the rate of change of bending of the actual lines so far as they cut the armature coils, the reason being that the M.M.F. of the commutating poles will never by itself straighten the distorted lines near the coils within the slots, so that the third part of the inductance cannot be strictly annulled but must be compensated for. Although the distinction between the natural and the available period of commutation is, up to a certain point, useful and valid, it contains an element of indefiniteness which rather limits its usefulness. The shape of brush, too, recommended by the author may be compared with the serrated edges which Mr. Carter (in the *Electrical World*, March 31st, 1910) recommends from an analogous point of view—viz., as valuable in unfavourable cases for keeping the current density at the last moment finite.

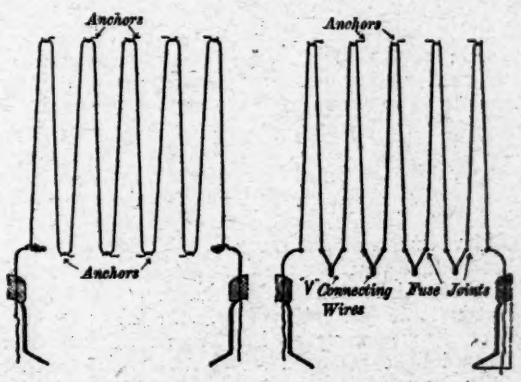
MR. F. J. MOFFETT (Birmingham) (communicated): A case recently came under my notice in which a machine was designed for an output of 1,000 amperes at a voltage of 80 and a speed of 700 R.P.M. It was provided with commutating poles. The brushes used consisted of a mixture of copper dust and carbon (Morganite Link 2/538), the current density being 85 amperes per square inch. When running at full load the commutation at the positive brushes was very good, but trouble was experienced at the negative brushes, the wearing surface of which not only showed the brown bands mentioned by the author, but the copper was removed, leaving the carbon alone. With an overload of 20 per cent. or 1,200 amperes on the machine, the commutation at the positive brushes was still fairly good, but at the negative the sparking became so vigorous as to make it impossible to continue the run. The removal of the copper from the negative brushes was even more marked at the overload than at normal full load, and the brushes became extremely hot. In order to remedy this trouble, it was decided to substitute soft carbon (Morganite Link 1/289) for the copper-carbon brushes on the negative poles, although these were naturally of higher resistance. The effect of the change was remarkable; not only was the commutation at normal load almost perfect, but even at 1,200 amperes there was no serious fault to find, and the alteration was quite successful in permanently curing the trouble. From an examination of the copper-carbon brushes on the positive and negative poles respectively, there appeared to be some justification for the assumption that the copper was carried along by the current by a kind of electrolytic action, but it is possible that the temperature at the contact surface of the negative brush reached so high a value as to render the copper molten, in which state it was carried away by the commutator segments. In support of this explanation I may mention that in the space between the commutator segments there was a considerable amount of copper which did not appear to be derived from the commutator bars.

MR. H. G. STEPHENS (Leicester) (communicated): I would suggest that the experiments be carried further. For instance, the case when only one coil is short-circuited is the simplest possible case, and is comparatively rare in practice. Straight-line commutation is not always a desideratum, as in the case of high-speed machinery, *e.g.*, turbo-generators, accelerated commutation is sometimes found to give better results.

MR. WORRALL, in reply, stated that the method of cancelling the tooth oscillations suggested by Dr. Kloss would only be possible in the case of a machine in which the workmanship was perfect and the magnetic quality of the iron uniform. No oscillograms were taken of the field exciting current, but from previous experience with laminated pole shoes and limbs it was evident that the non-existence of magnetic oscillations in the yoke was due mainly to the use of solid poles and limbs. If the oscillograph were connected across the brushes, the main E.M.F. would be so large that all commutation ripples would be invisible on the record; this could be overcome by the use of a constant opposing E.M.F., but the result would be confused by the variations of E.M.F. due to the spacing of the winding. The remarkable confirmation of the results by Mr. Moffett was of very great interest. The suggestion of Prof. Marchant regarding the vibration of the negative brush did not explain the fact that the brush when positive did not vibrate even without the cooling device.

NEW TUNGSTEN LAMP.

IN a paper entitled "A New Form of Tungsten Lamp," Mr. Charles F. Scott, of the Westinghouse Electric and Manufacturing Co., describes a tungsten lamp called the "wire type," which has been developed by the engineers of the Westinghouse Lamp Co. The accompanying illustrations compare the wire type with the usual type of tungsten lamp. The main elements of the former are a single long filament, intermediate hook supports which hold the filament loosely, and a terminal which is described as mechanically and electrically adequate. The common tungsten lamp consists of a number of filaments in series, the individual filaments having their ends fused together to stiff supporting wires. In the new lamp the single filament is wound back and forth around hook supports at numerous points, and a few turns near each end are wound in the form of a spiral around the respective leading-in wires, and the ends fused. The several turns of the filament around the leading-in wires act as a sort of a spring, so that a slight bending of the filament, resulting from a blow or vibration, does not act directly upon the fused joint, as would be the case if the straight part of the filament came directly from the fused joint as in ordinary construction. Furthermore, carelessness in the act of fusing is stated to be of minor consequence in the wire type of lamp, whereas it might seriously lessen the strength of the filament in the common forms of lamp.



FILAMENTS OF NEW AND OLD TUNGSTEN LAMPS.

A tungsten lamp using, say, five filaments, is analogous to five independent lamps in series, and its life will be fixed by that of the weakest filament. On the other hand, a process in which a yard or more of filament is made in one piece is not liable to the conditions which are possible and probable when a lamp contains several filaments which have been made at different times, and under the necessarily different conditions incidental to commercial manufacture. It is stated that the mechanical excellence of the new lamp is attested by the result of comparative experiments with such lamps and lamps of the ordinary type. Among these was a test consisting in dropping a weight on a board, held on supports about 4 ft. apart, to which lamp sockets were attached. It was found that, with the wire type, the weight had to fall from four times the height to cause the same destruction as with the fused type of lamp. It is stated that the wire-type tungsten filament is made in long lengths, the present equipment making several miles a day.

Observation would seem to indicate that the life of the wire lamp will be even greater than that of the present tungsten lamp by reason of the better mechanical arrangement of the filament. Although 18-watt lamps have been built, it is probable that the lowest standard rating will be 25 watts. These new lamps will be placed on the market at the same price as the present tungsten lamps.—*Electrical World.*

SOME CONSIDERATIONS ON THE FUEL QUESTION.

By G. BASIL BARHAM, A.M.I.E.E.

There is no doubt that the present position of the central station, financially considered, is such as to render it necessary for economies to be effected and efficiency improved wherever possible. The introduction of the metallic-filament lamp has been followed by a serious drop in revenue, and the reduction must be compensated for by an increased use of electrical energy, and also by, if possible, a reduction in works costs. Many engineers have turned their attention to the question of encouraging the use of electricity for domestic purposes other than lighting; few, however, have turned their attention to the matter of costs, feeling that whatever was possible in the direction of cutting these down had already been done. The prices paid for general stores, oil, waste, &c., are already very low, owing to the severe competition between suppliers; and the item of wages is usually as low as is compatible with the work done. It would therefore seem that the only direction in which improved economy can be effected, is in connection with the generating plant.

The design and construction of steam engines have advanced considerably during the past few years, and from a study of existing types it would appear unlikely that any further development will occur in the near future. Indeed, finality would almost appear to have been reached in the efficiency of the steam engine, whether of the reciprocating or turbine type; and those who are most closely in touch with the boiler-making industry consider that little improvement of existing designs is to be expected. As a matter of fact, there has been little improvement in boiler efficiencies for some years; 70 per cent. efficiency for ordinary working practice, and about 80 or 82 per cent. under the most favourable testing conditions, being apparently the best results obtainable.

If no improvements can be looked for in either engine design or construction or in boiler making, the only directions left in which steam plant economies may be sought are in connection with the construction of furnaces, with a view to obtaining an improved heating effect from the coal; and, secondly, in the use of cheaper forms of fuel, such as bituminous or anthracite slack, coke breeze or lignite. Coke breeze, although reasonably cheap, and suitable for fuel purposes, is so rarely obtainable in quantities at any distance from the coke ovens, that its use need not be considered here.

As upwards of one million tons of coal are burned per week in the United Kingdom alone, it is evident that the question of conserving our coal supply by the use either of coal substitutes or of low-grade coals, is one of importance, and, indeed, it is remarkable that greater attention has not been given to the prevention of the waste incurred by using good quality coal, where an inferior quality could be used with practically equal results. Much has been done in this direction by municipalities in utilising town refuse for power production. It is, of course, recognised that a higher capital expenditure for plant is involved where low grade fuel is used, and that the costs of handling are greater, but at the same time experience has shown that excellent economic results can be obtained from burning refuse of a comparatively low calorific value. In this country there are at least nine, if not ten, municipally-owned destructors which are commercially successful, in as much as that, after meeting all charges that can be legitimately allotted to them, a net surplus remains as the result of the year's working.

In certain collieries in South Wales and Yorkshire, use is being made of the tens of thousands of tons of low-grade shales and refuse from the coal-washing plants, which have been dumped in heaps in the neighbourhood of the pits. As may be expected, this material is not burned in internal furnaces, but in furnaces somewhat after the destructor type. It is said that a grate area of 50 sq. ft. or more can be thus provided for an ordinary Lancashire type boiler of 8 ft. diameter. It is evident that the large area of incandescent firebrick surface which is opposed to the cooling surface of the boiler is an important factor in the combustion of such fuels. The facility with which shale and coal dust can be burned under such conditions is probably accounted for by the large grate area, and the fact that cold air is prevented from coming into contact with the boiler plates.

The possibility of using such fuels in connection with the generation of electricity is confined to the neighbourhood of the dump heaps, and, in view of the cost of carriage and the outlay necessary for furnace alterations, it is evident that they could not be economically employed in stations at any distance from the coal-washing plant. But without seeking to use fuels of so low a grade as these, the desirability of using bituminous or anthracite slack, or lignites where obtainable, cannot be called into question, provided that an ample supply can be relied upon at a reasonable cost for freightage. If, on the other hand, the cost of carriage is considerable, or the supply could not be depended upon, the improved results obtained from the employment of a higher grade of coal would more than balance the economy resulting from a cheap fuel of lower evaporative power.

If a low-grade fuel is substituted for one of greater calorific value, expense will probably be incurred in alterations to the boiler setting, the grate surface and the draught appliances. In the first place, to furnish the same amount of heat as was yielded by the better quality fuel, a greater quantity of the slack or lignite must be burned per hour—a fact which means an increase in the cost of handling. The grate surface must have narrow air-spaces. Probably the most useful type of fire-bars for burning slack are what are known as pin-hole bars, which are perforated with round holes $\frac{3}{8}$ in. in diameter. As, however, these bars have a low percentage of air space, seldom amounting to more than 10 per cent. of the total surface, they are invariably used with forced draught. The herring-bone type of bar, with air-spaces $\frac{1}{4}$ in. in width, can be used with either natural or forced draught, as this type gives about 30 per cent. of air space—an amount which is quite sufficient without the assistance of air blast. Many engineers hold the opinion that at least 45 or even 50 per cent. of air space is necessary; but even if such a large percentage is an improvement, which is not admitted, the improvement is more than balanced by the waste involved, due to green and partially burnt fuel falling through into the ashpit.

It may be stated here that it is difficult to obtain the highest economy from the use of bituminous slack in a boiler fitted with an ordinary grate, and by hand firing. On the other hand, it may be demonstrated that the outlay incurred in putting down mechanical stokers will be speedily repaid by the considerable economy effected. A leading authority has stated that, of all known methods of burning soft coal, the worst is the one most commonly practised, namely, that of burning it in a common furnace consisting of a set of fire-bars and a space of contracted dimensions between them and the heating surface of the boiler, the coal being fired by hand. This method is suitable for anthracite coal, but when used for bituminous coal it is objectionable, both on account of the smoke and the amount of waste involved.

Were the same grate area to be used for a cheap as for a high-grade fuel, the number of pounds burned per hour would have to be increased if the same output of steam had to be maintained. A deeper bed of fuel on the bars would therefore be necessary, and there would consequently be an increased resistance to the passage of air through the mass, which of itself would render forced draught necessary. But where the grate area is increased and the fuel is spread lightly and evenly over the grate at frequent intervals, in spite of the necessity for more frequent cleaning, a practised attendant will obtain the same results, as regards steam raising, with bituminous slack as with coal of a larger size.

The first result of spreading a quantity of green slack on a fire is to choke the air supply by shutting off the countless air passages which have formed in the glowing mass already in the furnace. The moisture which is contained in the slack is rapidly given off, appreciably lowering the temperature of the furnace, which is still further chilled by the formation of water gas from the decomposed steam and

carbon. The volatile hydrocarbons then commence to distil, and the greater portion of these are carried away unburnt owing to the comparatively low temperature. Considerable quantities of smoke, containing water gas, finely divided carbon, unburned hydrocarbons, and hydrogen are given off, and in addition to the serious loss incurred in this way, soot is formed on the heating surfaces and the efficiency of the plant is further impaired.

Unless the bed is very thick and green, the volatile matter will be quickly driven off and air passages formed in the mass. The temperature of the furnace will at once commence to rise, the fixed carbon residues will be burned, and the emission of smoke will cease. In a short time the fuel bed will have burned low and a further charge of slack be necessary, causing the cycle from inefficiency to efficiency to be repeated.

With green slack coal the furnace doors must be frequently opened for slicing and cleaning; every opening of the door means a lowering of temperature and consequent loss of efficiency. In order to prevent this frequent opening of the furnace, the coal must be fed evenly and thinly, and so some form of mechanical stoker is essential. The green coal must be so fed that the heat of the furnace will gradually expel the volatile matter, and the gases formed in this way must be mixed with sufficient air to ensure that they are thoroughly oxidised. The mixture must be heated to ignition point immediately it is formed, and not allowed to cool in any way and so be carried off unburned. To fulfil these requirements, a combustion chamber of ample size, lined with fire-brick, must be provided.

The selection of a type of mechanical stoker is outside the scope of this article. Of the overfeed, underfeed, and chain-grate types, probably the underfeed is the most generally useful. A useful pattern is that in which a screw conveyor is used to force the slack into the centre of the furnace. The slack is slowly roasted as it approaches the fire, and the gases which arise are mixed with a supply of hot air under pressure, which enters below the fire-bars from tuyeres. The oxidised gases are driven through the glowing fuel in the furnace and are completely consumed. A strong point in connection with stokers of this pattern is the complete control obtainable over the forced draught, which may be divided in any desired proportion between ashpit and tuyeres by the opening or closing of the ashpit doors. Further, with underfeed stokers there is no waste of fuel through green or partially-burned coal falling into the ashpit.

Going further into details, it may be said that slack coal may contain from 8 to 10 per cent. of moisture, which has to be taken into consideration. With anthracite coal slack it is only necessary to calculate out the amount of moisture and ash, in order to compare its heat value with larger-sized coal. The following figures have been worked out in connection with this point, and it has been assumed that the heat value of anthracite is equal to 14,500 B.TH.U. The large coal is considered to contain 8 per cent., and the slack coal 16 per cent. of ash, from which it will be seen that the heat value per lb. of dry coal will be 13,340 B.TH.U., and of slack coal 12,180 B.TH.U. It has been further assumed that the practical efficiency of the boiler and furnace combined will be 70 per cent., so that the result will be 9·67 lb. of water evaporated per lb. of large coal at a temperature of 212° F., and 8·82 lb. from the slack. To develop 1 boiler H.P., taking these figures as approximately correct, will therefore require 3·57 lb. of the large and 3·91 lb. of the slack coal. As will be seen, this calculation is based on dry coal and slack; the percentage of moisture in the latter, as compared with that in the former, must be taken into account.

To emphasise this question of cheap fuel, some figures from a typical plant may be given. In this plant the efficiency is 67 per cent., the remaining 33 per cent. representing the losses by ashes, boiler radiation, leakage and smoke stack. These losses might be reduced somewhat by the substitution of modern appliances throughout, but the cost of fitting them would certainly more than balance the saving effected. Details of this plant may be quoted as follows:—Reciprocating engines of 7,500 H.P., with a mechanical efficiency of 93·65 per cent., are used, and at maximum economy the steam consumption is approximately 17 lb. per KW.-hour, equivalent to 20,349 B.TH.U. per KW.-hour. Since 1 KW.-hour is equivalent to 3,412 B.TH.U., the actual efficiency of the combined engine and generator is 16·7 per cent. only. The efficiency of the generator is approximately 98 per cent., so that the thermodynamic efficiency of the engine is 17 per cent. With a compound engine of small size, 20 to 30 lb. of steam are required per H.P.-hour, simple engines need from 30 to 50, simple pumps from 100 to 200, and compound pumps from 60 to 100. One H.P. equals 2,545 heat units per hour, and as it requires approximately 1,000 heat units to produce 1 lb. of steam at a pressure of from 80 to 125 lb. under working conditions, it can be seen that with a compound engine of about 400 H.P., only about 10 per cent. of the energy in the steam is used. With a simple pump, only about 1·5 per cent. of the energy is turned to useful account. If all the heat units in the coal are considered, the engine would use 7 and the pump 1 per cent. It can therefore be demonstrated that with a highly efficient plant only 10·3 per cent. of the 14,500 (or, to be exact, 14,150) B.TH.U. in the coal is delivered at the bus-bars. Obviously, therefore, the doubling of the efficiency of the steam pump, for example, would still leave the set wasting 98 per cent. of the heat units available, whilst if the efficiency of the coal could be doubled, the losses would only amount to 50 per cent. Saving in minor parts of the plant means that the economy is only effected whilst the engine is in operation, as a general thing; increasing the coal efficiency, or what is the same thing, obtaining the same steam with a cheaper quality, means a continuous saving for 24 hours per day for 365 days per annum.

OUR LEGAL QUERY COLUMN.

[*Questions addressed to this column should be written on one side of the paper only.*]

"RESIDENT ENGINEER" writes:—"Can you kindly inform me regarding the legal position in the following circumstances?—

"An armoured distributing cable is laid under the footpath in the ordinary way, at a depth of 15 in. from the surface of the path. A time comes when the local authority wishes to widen the roadway, and for this purpose sets the kerb back, so that the armoured cable is then in the roadway, at a depth of 11 in. from the road surface. In my opinion, with the less depth from the surface and the heavy traffic above it, the cable is now unsafe. I should be glad to know—

"1. Whether the local authority is responsible for any damage that may result to the cable if I leave it where it is.

"2. If I divert the run of the cable, so as to bring it under the footpath again, or, as an alternative, sink it down deeper, can I make the local authority bear the expense?

"Have any cases similar to the above been decided by the Courts? I shall be glad of any information."

*** It is clear that where a road authority seeks to interfere with a road in such a way as to affect electric cables, it must have due regard for the existence of such cables.* Where the highway authority proposes to alter the position of any cable, it must give immediate notice to the undertakers, showing the exact nature of the works to be carried out (Electric Lighting Clauses Act, 1899, Schedule, Sec. 17), and the expense of such alteration must be borne by the highway authority, which is apparently responsible for negligence (see Cressy *v.* South Metropolitan Gas Co. (1906) 94 L.T. 790). There is no case or statute, however, which decides the question of liability in the circumstances mentioned by "Resident Engineer." Before hazarding an opinion, it would be necessary to be more conversant with the facts.

Electrical Smelting of Iron Ore. — The British Acting Consul at Christiania reports that an experimental furnace for the electric smelting of low-grade iron ores into pig-iron has recently been erected at Tinnfos. About 60 tons of this pig-iron have been sent to foreign steelworks for conversion into steel, and the quality has been found to be very good. The cost of smelting at Tinnfos is stated to be about £3 1s. per ton. It is intended to erect a new and larger furnace, worked by power from the Tinnfos waterfall, where about 15,000 H.P. will be available upon completion of the necessary works. It is hoped eventually to produce some 50,000 tons of pig-iron a year, which will be converted into steel by electrical process.—*Board of Trade Journal.*

* See, generally, "Emden's Building Contracts," fourth edition, by Matthews and Valentine Ball, page 348.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

PORTO RICO.—All articles which are capable of being marked, stamped, branded or labelled without injury must be so treated in legible English words, in a conspicuous place, so as to indicate the country of origin. Such marking must be as nearly indellible and permanent as the nature of the article will permit. The country of origin must, moreover, be stated on all packages. Invoices must be produced to the Consular officer of the United States in the district in which the goods were manufactured or sold, and must have endorsed on them a declaration signed by the manufacturer, owner or agent that the invoices are in all respects correct and true, and were made out at the place from which the goods were exported. The value on which *ad valorem* duty is calculated is the value of the goods as sold for home consumption in wholesale quantities in the principal markets of the country of origin, with the addition of cost of packing and packages and all expenses necessary for placing the goods in a condition ready for shipment.

Dollar = 100 cents = 4s. 2d.

Electrodes, brushes, plates and disks, wholly or in chief part of carbon	30 % ad val.
Carbons for electric lighting, wholly or partly finished :	
Made entirely from petroleum coke ...	35 cents per 100 ft.
Made chiefly of lampblack or retort carbon	65 „ „
Porous carbon-pots for electric batteries, without metallic connections	20 % ad val.
Railway rails	$\frac{1}{10}$ cent per lb.
„ fishplates	$\frac{3}{10}$ „ „
Iron or steel wire, round :	
Not smaller than No. 13 wire gauge ...	1 „ „
Smaller than No. 13 and not smaller than No. 16	1¼ „ „
Smaller than No. 16	1¾ „ „
Iron or steel wire coated by dipping, galvanising or similar process, in addition to the rate imposed on the wire from which it is made (see above)	$\frac{3}{10}$ „ „
Telegraph, telephone and other wires and cables composed of metal and rubber, or of metal, rubber and other materials	40 % ad val.
Wheels or tires for railway purposes	1½ cents per lb.
Copper in rolled plates	2½ „ „
Steam engines	30 % ad val.
Other machinery	45 % „

The Fixation of Atmospheric Nitrogen in France.

—The French company, "La Nitrogène," has just started a factory at Roche de Rame (Hautes-Alpes) for the production of nitric acid and other nitrated products by means of the electric arc. A licence has been acquired from the Saltpetersaure I.G. for the sole use of the Pauling method in France and her Colonies. The power used is obtained from a fall on the Biaisse, a tributary of the Durance, the installation being composed of four units of 2,000 H.P. each. The works are situated opposite the generating station, on the left bank of the Durance, adjoining the Roche de Rame railway station. The furnaces are arranged in two rows in a separate building, and are composed essentially of a vertical shaft constructed of refractory bricks. Two cast-iron electrodes are inserted through the masonry, the ends almost meeting in the shape of the letter V. Between the spark-gap a jet is fixed, through which compressed air is forced. This air blast serves the two-fold purpose of drawing out the arc and forming synthetic nitric acid. Each furnace has two arcs in series. A three-phase alternating current of 50 periods at a pressure of 4,000 volts is used. The phases are divided equally between three furnaces. At present the furnaces constructed absorb 500 H.P. each, but it is probable that this will be raised to 1,500 H.P. in the future. The hot nitrous fumes issuing from the shaft give up part of their heat to the compressed air used for blowing. From here these fumes are carried by means of fans into two brick towers, where the cooling operation is finished. The gas then passes to a tower 10 m. in diameter × 22 m. high, where oxidation is completed. Following this are five absorption towers, each of which is provided with a pump and an apparatus for the distribution of the absorbing liquid. In another tower nitric acid is concentrated, any strength up to 96 per cent. being obtained at will. The last traces of unabsorbed gas are finally utilised for the production of sodium nitrite. In normal working the yield of acid is from 60 to 70 grammes per KW.-hour. The cost of installation never exceeds 120 fr. per KW. The whole plant works practically automatically, very little hand labour being required. The recent working of this factory has interested the chemical world in particular, on account of the high degree of purity of the product. The acid obtained is free from all the objectionable impurities usually present, and particularly from chlorine. The installation of the Paulin plant is of great interest, as it will in future have to meet the competition of the Norwegian company in the world's market for artificial manures and other nitrated products.

NEW PATENTS APPLIED FOR, 1910.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co Electrical Patent Agents, 285, High Holborn, London, W.C., and Liverpool and Bradford, to whom all inquiries should be addressed.

16,470. "Improvements in petrol-electric transmissions for vehicles and launches." W. A. STEVENS. (Date applied for under Rule 13, June 7th, 1910. An invention comprised in Application No. 13,747, dated June 7th, 1910.) July 11th.

16,478. "Anchor insulator for metallic cable suspender." J. M. THOMSON, jun. July 11th.

16,485. "Quick-break switch or circuit-breaker, applicable to arc lamp and other electrical circuits." T. LITTLER, jun. July 11th.

16,486. "Improved interlocking switch or fuse or gate-end box for electric lighting or power transmission cables." W. PATON. July 11th.

16,501. "Improved electro-magnetic friction clutch." C. W. HILL. July 11th.

16,522. "Improvements in electrical resistance furnaces." O. SERPEK. (Application for Patent of Addition to No. 12,601/1910.) July 11th. (Complete.)

16,575. "Electric lighting cable slip-plug connector for electrically lighted trains." H. LEASON. July 12th.

16,620. "Improvements in and relating to an electrically-operated playing apparatus for musical instruments and music sheets therefor." D'ARCY M. CLARK. (Telectric Co., United States.) July 12th. (Complete.)

16,636. "Electromagnetic lock." R. A. DAVIES. July 12th.

16,709. "Apparatus for coating moulds for electrotyping and the like." A. W. PENROSE & Co., LTD. (G. Benedict, United States.) July 13th. (Complete.)

16,755. "Electrolysing alkali amides and the manufacture of products such as alkali metals, alkali amides, cyanamides and cyanides and other organic compounds." E. A. ASHCROFT. July 13th.

16,763. "Improvements in alternating-current and alternating and direct-current machines." L. KLEIN. July 13th. (Complete.)

16,764. "Improvements in the electrolytic treatment of halogen salts of the alkali metals for the production of the metals or their derivatives and halogens, and the apparatus therefor." E. A. ASHCROFT. July 13th.

16,841. "Electric arc lamps for two or more pairs of electrodes." AUGUST SCHWARZ BOGENLAMPENFABRIK. (Date applied for under Sec. 91 of the Act, July 28th, 1909, being date of application in Germany.) July 14th. (Complete.)

16,844. "Improvements relating to high-tension magneto electric apparatus." F. R. SIMMS and SIMMS MAGNETO Co., LTD. July 14th.

16,997. "Electric speed regulation of machines." SIEMENS SCHUCKERTWERKE G.m.b.H. (Date applied for under Sec. 91 of the Act, July 17th, 1909, being date of application in Germany.) July 16th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of MESSRS. W. P. THOMPSON & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1909.

OPTICAL ELECTROMAGNETIC SPEED INDICATORS. W. Henwood. 9,242. April 19th.

DYNAMO-ELECTRIC MACHINES. H. Walker. 11,956. May 20th.

ELECTRIC OVENS. J. G. Childs and T. S. Hill. 14,548. June 21st.

HOLDERS FOR INCANDESCENCE ELECTRIC LAMPS. A. E. Lamkin and T. R. Nunwick. 14,763. June 23rd.

ELECTRIC CLOCKS. F. Holden. 14,873. June 26th.

MAGAZINE ELECTRIC ARC LAMPS. Johnson & Phillips, Ltd., and J. Brockie. 15,287. June 30th.

DEVICES FOR PRODUCING ELECTRICAL OSCILLATIONS. W. E. Lake. (Polyfrequenz Elektricitäts Ges.) 16,558. July 15th.

PORTABLE MAGNETIC COMPASSES. L. W. P. Chetwynd, Kelvin & James White, Ltd., and F. W. Clark. 16,607. July 16th. (Application for Patent of Addition to No. 21,634 of 1908.)

QUICK MAKE AND BREAK ELECTRIC SWITCHES. A. West. 16,649. July 16th.

ELECTRIC MOTORS. D. Maggiora and M. Sinclair. 17,863. July 31st.

ELECTROMAGNETIC DEVICE FOR VARYING THE INTENSITY OF LIGHT OF ELECTRIC LAMPS AND FOR PERMITTING THE USE OF LOW-VOLTAGE LAMPS ON HIGH-VOLTAGE CIRCUITS. A. de Stefano. 19,465. August 24th. (Date applied for under International Convention, August 26th, 1908.)

INSTALLATION OF ELECTRICAL CONDUCTORS. J. S. Highfield. 21,021. September 14th.

INSULATOR FOR SUPPORTING THE CURRENT RAILS OF ELECTRIC RAILWAYS AND TRAMWAYS. A. Watkins. 21,526. September 21st.

ELECTRIC HEATERS. J. C. Royce. 21,564. September 21st.

ELECTRIC TELEGRAPHY. A. Muirhead and Muirhead & Co., Ltd. 23,429. October 13th.

APPARATUS FOR THE PRODUCTION OF CONTINUOUSLY-MAINTAINED AND SUSTAINED OSCILLATIONS OF ELECTRICITY. H. Manders. 24,134. October 20th.

DENTAL APPLICATOR FOR USE WITH ANY ELECTRIC MASSAGE VIBRATOR. C. Brice. 27,705. November 29th.

ELECTRICAL IGNITION APPARATUS FOR INTERNAL-COMBUSTION ENGINES. H. W. Van Raden. 29,026. December 11th.

1910.

ELECTRIC MOTOR POWER TRANSMISSION. M. W. Farrell. 722. January 11th.

APPARATUS FOR AUTOMATICALLY TRANSFERRING ARTICLES TO AND FROM A MACHINE IN WHICH THEY RECEIVE TREATMENT. British Thomson-Houston Co. (General Electric Co.) 1,038. January 15th.

RECTIFIER FOR HIGH-TENSION ALTERNATING CURRENTS. Siemens & Halske Akt.-Ges. 5,917. March 9th. (Date applied for under International Convention, May 28th, 1909.)

ELECTRICAL OPERATION OF GUN MECHANISM AND THE LIKE. H. C. Leake. 12,709. May 25th. (Date applied for under Rule 13, June 18th, 1909.)